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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 07/16/82		3. REPORT TYPE AND DATES COVERED
4. TITLE AND SUBTITLE CONCEPTUAL DESIGN ANALYSIS, NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM, ROCKY MOUNTAIN ARSENAL, COMMERCE CITY, CO, FY82			5. FUNDING NUMBERS	
6. AUTHOR(S)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  STEARNS-ROGER ENGINEERING CORPORATION DENVER, CO			8. PERFORMING ORGANIZATION REPORT NUMBER  88273R02	
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12a. DISTRIBUTION/AVAILABILITY STATEMENT  APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) <p>THE PURPOSE OF THIS CONCEPT DESIGN ANALYSIS IS TO DEFINE THE FOLLOWING FOR THE NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM:</p> <ol style="list-style-type: none"> <li>1. FUNCTIONAL AND TECHNICAL REQUIREMENTS</li> <li>2. BUILDING AND EQUIPMENT REQUIREMENTS</li> <li>3. SUPPORT SYSTEMS.</li> </ol> <p>SPECIFICATIONS ARE INCLUDED FOR THE FOLLOWING ELEMENTS:</p> <ol style="list-style-type: none"> <li>1. CARBON TREATMENT SYSTEM</li> <li>2. SITE DEVELOPMENT - GRADING AND PLACEMENT</li> <li>3. BUILDING DETAILS - WALLS, FLOORS, ETC.</li> <li>4. STRUCTURAL DETAILS - STEEL AND FOUNDATIONS</li> <li>5. MECHANICAL - PLUMBING AND PIPES</li> <li>6. ELECTRICAL.</li> </ol> <p>VOLUME II CONTAINS COST ESTIMATES AND DESIGN CALCULATIONS.</p> <p style="text-align: right;">DTIC QUALITY INSPECTED 8</p>				
14. SUBJECT TERMS  SANITARY SEWER, COST, CONSTRUCTION, EQUIPMENT, SPECIFICATIONS			15. NUMBER OF PAGES	
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17. SECURITY CLASSIFICATION OF REPORT  UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

88273R02  
VOLUME II

CONCEPTUAL DESIGN ANALYSIS  
NORTHWEST BOUNDARY CONTAINMENT/  
TREATMENT SYSTEM  
ROCKY MOUNTAIN ARSENAL  
COMMERCE CITY, COLORADO  
FY 82 MCA LINE ITEM 37  
DACA 45-82-C-0064  
VOLUME II

Prepared By  
STEARNS-ROGER SERVICES INC.  
4500 Cherry Creek Drive  
P.O. Box 5888  
Denver, Colorado  
80217

Project No.  
C-26616

16 July 1982

19950705 114

DTIC QUALITY INSPECTED 8

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Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
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CONCEPT DESIGN ANALYSIS  
NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM

VOLUME II

SECTION 1 - COST ESTIMATE BACKUP

SECTION 2 - DESIGN CALCULATIONS

# Stearns-Roger

## CRAFT WAGE RATES (Denver Area)

<u>TRADE</u>	<u>Rate Per Hr.</u>	<u>Health &amp; Welfare</u>	<u>Pension</u>	<u>Vacation</u>	<u>App. Train.</u>	<u>Other</u>	<u>Average PT&amp;I</u>	<u>Total Per Hr.</u>
Carpenters	14.87	1.20	.85	1.00	.11		3.56	21.59
Electricians	17.85	.34	1.25		.06(2)	.58(1)	3.96	24.04
Pipe Fitters/ Plumbers	16.82	1.00	1.50	1.00	.08		4.02	24.42
Laborer	10.23	1.04	.70	.75	.10	.05(3)	2.54	15.41
Operating Engrs. Group 5	13.90	1.19	1.20	.60	.12	.05(4)	3.36	20.42
Millwrights	16.76	1.20	1.00		.29		3.80	23.05
Ironworkers	16.55	1.19	1.35		.17		3.80	23.06
Cement Masons	15.69	1.04	1.35		.13	.05(4)	3.60	21.86
Painter	15.61	.91	1.15		.08	1.42(5)	3.79	23.00

### Notes:

- (1) NEBF = 3% of Gross.
- (2) Apprentice Training = 0.03% of Gross.
- (3) Industry Promotion.
- (4) Construction Advancement Program.
- (5) Estimated Increase for 1982 - 8%.

PTI Average For Denver Area For  
The Above Crafts = 19.72018%











CONSTRUCTION COST ESTIMATE				DATE PREPARED		SHEET 1 OF 4	
PROJECT N.W. BOUNDARY GROUND WATER CONTROL SYSTEM				BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION ROCKY MOUNTAIN ARSENAL-COMMERCE CITY, CO							
ARCHITECT ENGINEER STEARNS, ROGER				26616			
DRAWING NO.		ESTIMATOR STEVE V.W.		CHECKED BY			
ARCHITECTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Preengineered Metal Bldg 40x72'8x30'eave (see Manufacturer confirmation letter)	1			Sub-contract			\$64,300.00
TOILET ROOM							
• 6" Reinforced block wall 14'6"x8'H-3'7" door	120 25	SF HR	21.86 /HR	\$ 546.50	\$1.00/SF	\$ 120.00	\$ 666.50
• Door 28"ø	1 3	ea HR	21.59 /HR	\$ 64.77	\$105/ea	\$ 105.00	\$ 169.77
• Door hardware	1	set HR	21.59 /HR	\$ 21.59	\$110/set	\$ 110.00	\$ 131.57
• Lavatory	1 3	ea HR	24.42 /HR	\$ 73.26	\$125/ea	\$ 125.00	\$ 198.26
• Soap Dispenser	.5	ea HR	21.59 /HR	\$ 10.80	\$24/ea	\$ 24.00	\$ 34.80
• Mirror	1 5	ea HR	21.59 /HR	\$ 10.80	\$46/ea	\$ 46.00	\$ 56.80
• Toilet Paper Dispenser	.5	ea HR	21.59 /HR	\$ 10.80	\$14/ea	\$ 14.00	24.80
• Paper Towel Dispenser	1 5	ea HR	21.59 /HR	\$ 10.80	\$25/ea	\$ 25.00	35.80
• Trash Container	1 5	ea HR	15.41 /HR	\$ 7.70	\$15/ea	\$ 15.00	\$ 22.70
Drinking Fountain	1 2	ea HR	24.42 /HR	\$ 48.84	265/ea	\$ 265.00	313.84
EMERG. EYE WASH & SHOWER	1 2	ea HR	24.42 /HR	\$ 48.84	335/ea	\$ 335.00	383.84
Sub-total				854.70		\$1184.00	2038.70
+ Subcontract							
TOTAL							\$66,338.70



CONSTRUCTION COST ESTIMATE				DATE PREPARED		SHEET 3 OF 4	
PROJECT N.W. BOUNDARY GROUND WATER CONTROL SYSTEM					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____		
LOCATION ROCKY MOUNTAIN ARSENAL - COMMERCE CITY, CO							
ARCHITECT ENGINEER STEARNS-ROGER							
DRAWING NO.			ESTIMATOR STEVE V.W.		CHECKED BY		
ARCHITECTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<b>Sewage Disposal</b>							
• Septic Tank - 500 gal	4	eq HR	20.42/HR	81.68	220/eq	\$220.00	\$301.68
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Dosing Tank	4	eq HR	20.42/HR	81.68	200/eq	\$200.00	\$281.68
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Trench	25	LF	24.42/HR	97.68	1.60/LF	\$40.00	\$137.68
4" clay pipe	4	HR	20.42/HR	40.84	—	—	40.84
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Distribution box	4	eq HR	20.42/HR	81.68	150/eq	\$150.00	\$231.68
excavation	2	HR	20.42/HR	40.84	—	—	40.84
backfill	2	HR	20.42/HR	40.84	—	—	40.84
• Leaching Field	140	LF	24.42/HR	97.68	1.00/LF	\$140.00	\$237.68
perforated PVC pipe	4	HR	20.42/HR	40.84	—	—	40.84
excavation 36"x20"x1'	2	HR	20.42/HR	40.84	—	—	40.84
backfill w/gravel	720	SF	20.42/HR	40.84	.24/SF	\$172.80	213.64
backfill covering	2	HR	20.42/HR	40.84	—	—	40.84
• Backhoe rental	2	DAY	—	—	495/DAY	\$990.00	990.00
3/4 CY							
				\$889.64		\$1912.80	\$2802.44

CONSTRUCTION COST ESTIMATE					DATE PREPARED		SHEET 4 OF 4	
PROJECT N.W. BOUNDARY GROUND WATER CONTROL					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION ROCKY MOUNTAIN ARSENAL - COMMERCE CITY, CO								
ARCHITECT ENGINEER STEARNS - ROGER								
DRAWING NO.			ESTIMATOR STEVE V.W.			CHECKED BY		
ARCHITECTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
Summary Sht								
SHEET 1				\$854.70		\$1184.00	2038.70	
+ Subcontract							64,300.00	
SHEET 2				\$496.19		\$213.38	\$709.57	
SHEET 3				\$889.64		\$1912.80	2,802.44	
<b>TOTAL</b>				2,240.53		3,310.18	\$69,850.71	
PREENGINEERED BLDG.				—		—	\$64,300.00	
TOILET ROOM				\$931.21		\$730.50	1,661.71	
SEWAGE SYSTEM				889.64		\$1912.80	2,802.44	
DRINKING FOUNTAIN				48.84		\$265.00	313.84	
EMERG. EYE WASH & SHOWER				48.84		\$335.00	383.84	
PAINTING				322.00		\$66.88	388.88	
				\$2,240.53		\$3310.18		
<b>TOTAL</b>							\$69,850.71	

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 1 OF 5	
PROJECT GROUND WATER TREATMENT FACILITY				BASIS FOR ESTIMATE			
LOCATION ROCKY MOUNTAIN ARSENAL				<input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
ARCHITECT ENGINEER STEARNS ROBERT ENGINEERING 266162							
DRAWING NO.		ESTIMATOR G. J. WHITTALL		CHECKED BY			
STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
							EQUIPMENT
EXCAVATION:							
TRENCHES & GRADE BMS	78.5	CY			102	\$80.07	80.07
	3.5	MH	15.41	\$53.94			53.94
BDDG FOUNDS & EQUIPMENT	54	CY			102	\$55.08	55.08
	3.0	MH	15.41	\$46.23			46.23
FLOOR & DOORWAYS	37.0	CY			0.43	\$15.91	15.91
	2.0	MH	15.41	\$30.82			30.82
	SUBTOTAL			130.99		151.06	282.05
BACKFILL:							
TO FOUNDATIONS ETC	72	CY			137	\$98.64	98.64
	2	MH	15.41	\$30.82			30.82
STRUCTURAL BACKFILL	58	CY			6.50	\$377.00	377.00
	17.5	MH	15.41	\$269.68			269.68
VAPOR BARRIER							
4 MILS P.V.C.	3708	SF			1.80	\$667.40	667.40
	8	MH	15.41	\$123.28			123.28
CONCRETE: FC 3000							
COMPLETE WITH FORMS							
& REBAR							
FLOOR SLAB	26.0	CY			58.00	\$1508.00	1,508.00
	34.0	MH	21.86	\$743.24			743.24
EQUIPMENT FOUNDS	44	CY			65.00	\$2860.00	2,860.00
	129	MH	21.86	\$2819.94			2,819.94
DOOR PADS	7.5	CY			58.00	\$435.00	435.00
	10.0	MH	21.86	\$218.60			218.60

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 2 OF 5	
<b>PROJECT</b> GROUND WATER TREATMENT FACILITY <b>LOCATION</b> ROCKY MOUNTAIN ARSENAL <b>ARCHITECT ENGINEER</b> STEARNS ROGER				<b>BASIS FOR ESTIMATE</b> <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
<b>DRAWING NO.</b>		<b>ESTIMATOR</b> G. J. WHITTALL		<b>CHECKED BY</b>			
STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
CONCRETE (CONT)							
BUILDING FOUND'S	8.1	CY			71 <sup>00</sup>	\$575.10	575.10
	32	MH	21 <sup>80</sup>	\$699 <sup>52</sup>			699.52
GRADE BMS & TRENCHES	53	CY			102 <sup>00</sup>	\$5,406 <sup>00</sup>	5,406.00
	440	MH	21 <sup>80</sup>	\$9618 <sup>40</sup>			9,618.40
GROUT 1" THICK	12.5	SF			3 <sup>50</sup>	\$43.75	43.75
	3.0	MH	21 <sup>80</sup>	\$65 <sup>58</sup>			65.58
GROUT 2" THICK	708	SF			7 <sup>00</sup>	\$4956 <sup>00</sup>	4,956.00
	227	MH	21 <sup>80</sup>	\$4962 <sup>22</sup>			4,962.22
EXPANSION AND ISOLATION JOINTS	498	LF			0 <sup>54</sup>	\$268.92	268.92
	11	MH	21 <sup>59</sup>	\$237 <sup>49</sup>			237.49
JOINT FILL	498	LF			0 <sup>17</sup>	\$84.66	84.66
	9	MH	21 <sup>59</sup>	\$194 <sup>31</sup>			194.31
STEELWORK							
CURB L FOR TRENCHES	240	LF			3 <sup>03</sup>	\$732 <sup>00</sup>	732.00
	24	MH	23 <sup>06</sup>	\$553 <sup>44</sup>			553.44
GRATING FOR TRENCHES 1/4" THICK	276.5	SF			6 <sup>85</sup>	\$1894.03	1,894.03
	11.0	MH	23 <sup>06</sup>	\$253 <sup>66</sup>			253.66
FOR WALKWAYS 1" THICK	312.5	SF			4 <sup>50</sup>	\$1406.25	1,406.25
	22	MH	23 <sup>06</sup>	\$507 <sup>32</sup>			507.32
ACCESS LADDERS	86	LF			25 <sup>00</sup>	\$2150 <sup>00</sup>	2,150.00
NO CAGE	33	MH	23 <sup>06</sup>	\$760 <sup>98</sup>			760.98

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 3 OF 5	
<b>PROJECT</b> GROUND WATER TREATMENT FACILITY				<b>BASIS FOR ESTIMATE</b> <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
<b>LOCATION</b> ROCKY MOUNTAIN ARSENAL							
<b>ARCHITECT ENGINEER</b> STEARNS ROGER							
<b>DRAWING NO.</b>			<b>ESTIMATOR</b> G. J. WHITTALL		<b>CHECKED BY</b>		
STRUCTURAL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<b>STEELWORK (CONT)</b>							
HANDRAIL & KICK	230	LF			22 <sup>00</sup>	\$5060 <sup>00</sup>	5,060.00
	37	MH	23 <sup>00</sup>	\$853 <sup>22</sup>			853.22
<b>ANCHOR BOLTS</b>							
1" $\phi$ x 18" LONG	40	EA			3 <sup>60</sup>	\$144 <sup>00</sup>	144.00
	22	MH	21 <sup>59</sup>	\$474 <sup>98</sup>			474.98
1" $\phi$ x 24" LONG	16	EA			4 <sup>25</sup>	\$68 <sup>00</sup>	68.00
	10	MH	21 <sup>59</sup>	\$215 <sup>90</sup>			215.90
3/4" $\phi$ x 18" LONG	24	EA			2 <sup>35</sup>	\$56.40	56.40
	10	MH	21 <sup>59</sup>	\$215 <sup>90</sup>			215.90
<b>EXPANSION BOLTS</b>							
3/4" $\phi$ x 7" LONG	16	EA			3 <sup>80</sup>	\$60.80	60.80
DRILLING	16	EA			0 <sup>47</sup>	\$7.52	7.52
	5	MH	21 <sup>59</sup>	\$107 <sup>95</sup>			107.95
<b>STEEL FRAMING TO WALKWAYS</b>							
	4402	lbs			0 <sup>60</sup>	\$2641.20	2,641.20
	75	MH	21 <sup>59</sup>	\$1619 <sup>25</sup>			1,619.25
				3,487.20			
					8,037.92		11,525.12







CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 2 OF 3	
<b>PROJECT</b> NW BOUNDARY TREATMENT FACILITY					<b>BASIS FOR ESTIMATE</b> <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
<b>LOCATION</b> ROCKY Mtn. ARSENAL, DENVER, COLO.								
<b>ARCHITECT ENGINEER</b> STEARNS - NOEL								
<b>DRAWING NO.</b>			<b>ESTIMATOR</b> TKO		<b>CHECKED BY</b> JMC			
HVAC	SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	PER UNIT	LABOR M. H. TOTAL	\$ PER UNIT	MATERIAL \$ TOTAL	TOTAL COST
SUBTOTAL PAGE 1					76.9		2694.20	
VENT CHIMNEY, 5" DIA.		100	LF.	25	25	2.50	250.00	
VENT CAP		4	EA	25	1	10	40.00	
PROPANE TANK 1000 GAL COMPLETE WITH ALL VALVES & FITINGS (EXC LPG TANK)		1	EA	16	16	1500	1500.-	
REGULATOR VALVE 3/4" DIA (EATON) TO RHTAIL		1	EA	1	1	40	40.-	
EXHAUST FAN 1/2 HP A FPM		1	EA	1		2	2.-	
DUCTWORK 20 FT 5" DIA GALV STEEL		20	FT	.62	12.4	.56	13.20	
WALL (KILLE 16"x16"		1	EA	1	1	5	5.-	
THERMOSTAT (PARCEL-COMAN TH-121)		1	EA	1	1	40	40.-	
SUBTOTAL PAGE 2					123.5		4645.20	

SHEET 3 OF 3

PROJECT

## NW BOUNDARY TREATMENT FACILITY

**LOCATION**

Rocky Mtn. Arsenal Denver Colo.

**ARCHITECT ENGINEER**

STEARNS - ROGER

Basis for Estimate	
1	100
2	100
3	100
4	100
5	100
6	100
7	100
8	100
9	100
10	100
11	100
12	100
13	100
14	100
15	100
16	100
17	100
18	100
19	100
20	100
21	100
22	100
23	100
24	100
25	100
26	100
27	100
28	100
29	100
30	100
31	100
32	100
33	100
34	100
35	100
36	100
37	100
38	100
39	100
40	100
41	100
42	100
43	100
44	100
45	100
46	100
47	100
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100	100

☐ CODE A (No design completed)

~~X~~ CODE B (Preliminary design)

☐ CODE C (Final design)☐ OTHER (Specify) \_\_\_\_\_

**DRAWING NO.**

ESTIMATOR

TKO

**CHECKED BY**

JMC

HVAC	SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
TOTAL FROM PG 2					123.5 MH		\$4645. <sup>20</sup>	
∴ COST OF LABOR		123.5	M.H.	\$24.42	3015. <sup>87</sup>			
∴ TOTAL COST					3015. <sup>87</sup>		4645. <sup>20</sup>	7661. <sup>77</sup>
BREAK OUT								
FUEL - PIPING					32.9		428.70	
- PROPANE TK					17.0		1540.00	
COST OF LABOR		49.9	M.H.	\$24.42	1218. <sup>56</sup>			
TOTAL COST - FUEL (SUPPORT UTILITIES)								3187.26

CONSTRUCTION COST ESTIMATE				DATE PREPARED <b>7-13-82</b>		SHEET <b>1</b> OF <b>5</b>	
PROJECT <b>NORTH WEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM</b>				BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION <b>ROCKY MOUNTAIN ARSENAL</b>							
ARCHITECT ENGINEER							
DRAWING NO.		ESTIMATOR <b>THORNLEY</b>		CHECKED BY			
PLUMBING SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL <i>M.H.</i>	PER UNIT	TOTAL	
<b>PIPE - ASTM B-88</b>							
<b>TYPE K</b>							
<b>3/4"</b>	107.0	LF	.19	20.33	1.62	173.34	
<b>1/2"</b>	15.0	LF	.16	2.40	1.17	17.55	
<b>FITTINGS</b>							
<b>WRIGHT COPPER</b>							
<b>SOLDER JOINT</b>							
<b>ANSI B16.22</b>							
<b>TEE</b>							
<b>3/4"</b>	1	EA	.67	.67	.52	.52	
<b>90° ELL</b>							
<b>3/4"</b>	8	EA	.42	3.36	.38	3.04	
<b>1/2"</b>	4	EA	.40	1.60	.14	.56	
<b>COUPLING</b>							
<b>3/4"</b>	4	EA	.38	1.52	.20	.80	
<b>BUSHING</b>							
<b>3/4" x 1/2"</b>	3	EA	.38	1.14	.20	.60	
<b>SUB TOTAL PAGE 1</b>				31.02		196.41	

CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-13-82		SHEET 2 OF 5		
PROJECT				BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____				
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.		ESTIMATOR THORNLEY		CHECKED BY				
PLUMBING SUMMARY SUBTOTAL PAGE 1		QUANTITY NO. UNITS    UNIT MEAS.		LABOR PER UNIT    TOTAL MH		MATERIAL PER UNIT    TOTAL		TOTAL COST
UNIONS -					31.02		196.41	
WROUGHT COPPER								
SOLDER JOINT								
1/2"		2	EA	.42	.84	1.47	2.94	
3/4"		2	EA	.44	.88	1.82	3.64	
VALVES - GLOBE								
125# BRONZE								
SOLDER JOINT								
1/2"		3	EA	.33	.99	11.50	34.50	
3/4"		2	EA	.40	.80	14.75	29.50	
SUBTOTAL PAGE 2					34.53		266.99	

CONSTRUCTION COST ESTIMATE				DATE PREPARED <i>7-13-82</i>		SHEET <i>3</i> OF <i>5</i>	
PROJECT <i>NORTH WEST BOUNDARY CONTAINMENT/</i> LOCATION <i>TREATMENT SYSTEM</i> <i>ROCKY MOUNTAIN ARSENAL</i> ARCHITECT ENGINEER				BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
DRAWING NO.		ESTIMATOR <i>THORNLEY</i>		CHECKED BY			
PLUMBING SUMMARY		QUANTITY		LABOR		MATERIAL	
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL MH	PER UNIT	TOTAL
<i>SUBTOTAL PAGE 2</i>					<i>34.53</i>		<i>266.99</i>
<i>PIPE - CAST IRON</i>							
<i>ASTM A-74 HUB</i>							
<i>W/PLAIN END SPIGOT</i>							
<i>SERVICE WEIGHT</i>							
<i>4' x 6'-6"</i>		<i>3</i>	<i>EA</i>	<i>2.36</i>	<i>7.08</i>	<i>4.68</i>	<i>91.26</i>
<i>4' x 6'-0"</i>		<i>2</i>	<i>EA</i>	<i>2.18</i>	<i>4.36</i>	<i>4.68</i>	<i>56.16</i>
<i>4' x 5'-0"</i>		<i>3</i>	<i>EA</i>	<i>1.82</i>	<i>5.46</i>	<i>4.68</i>	<i>70.20</i>
<i>4 x 10'-0"</i>		<i>2</i>	<i>EA</i>	<i>3.64</i>	<i>7.28</i>	<i>4.68</i>	<i>93.60</i>
<i>FITTINGS</i>							
<i>CAST IRON ASTM</i>							
<i>A-74 SERVICE WEIGHT</i>							
<i>NIPPLES</i>							
<i>4" x 1'-0"</i>		<i>4</i>	<i>EA</i>	<i>.36</i>	<i>1.44</i>	<i>4.68</i>	<i>18.72</i>
<i>4" x 1'-6"</i>		<i>4</i>	<i>EA</i>	<i>.55</i>	<i>2.2</i>	<i>4.68</i>	<i>28.08</i>
<i>4" x 2'-0"</i>		<i>4</i>	<i>EA</i>	<i>.73</i>	<i>2.92</i>	<i>4.68</i>	<i>37.44</i>
<i>4" x 2 7/8" (AS 1')</i>		<i>4</i>	<i>EA</i>	<i>.36</i>	<i>1.44</i>	<i>4.68</i>	<i>4.68</i>
<i>SUB TOTAL PAGE 3</i>					<i>66.71</i>		<i>667.13</i>



CONSTRUCTION COST ESTIMATE					DATE PREPARED <u>7-13-82</u>		SHEET <u>5</u> OF <u>5</u>	
PROJECT					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR <u>THORNLEY</u>		CHECKED BY			
PLUMBING SUMMARY		QUANTITY		LABOR		MATERIAL		TOTAL COST
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SUBTOTAL PAGE 4					<u>90.39</u>		<u>825.58</u>	
PIPE C.S.								
GALVANIZED								
ASTM A-120								
4"		<u>30</u>	<u>LF</u>	<u>.44</u>	<u>13.2</u>	<u>11.95</u>	<u>358.50</u>	
FLOOR DRAIN								
JOSAM SERIES								
3510 4"		<u>10</u>	<u>EA</u>	<u>1.33</u>	<u>13.3</u>	<u>41.40</u>	<u>414.00</u>	
FLOOR CLEANOUTS		<u>1</u>	<u>EA</u>	<u>1.33</u>	<u>1.33</u>	<u>14.40</u>	<u>14.40</u>	
JOSAM SERIES 8/84								
SUBTOTAL PAGE 5					<u>118.22</u>		<u>1612.48</u>	
TOTAL COST OF LABOR		<u>118.22</u>	<u>MH</u>	<u>24.42</u>	<u>2886.93</u>			
TOTAL COST OF MATERIAL							<u>1612.48</u>	
TOTAL COST								<u>4,499.41</u>

<b>CONSTRUCTION COST ESTIMATE</b>				DATE PREPARED 7-8-82		SHEET 1 OF 15	
PROJECT NORTH WEST BOUNDARY CONTAINMENT/					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____		
LOCATION ROCKY MOUNTAIN ARSENAL TREATMENT SYSTEM							
ARCHITECT ENGINEER STEARNS - ROGER 26616							
DRAWING NO.			ESTIMATOR FK		CHECKED BY Thomson		
SUMMARY	QUANTITY		LABOR M.H		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
MECHANICAL WORK							
PIPE PVC							
SCH 80							
1" DIA	10	LF	.24	2.4	.26	2.6	
1 1/2" DIA	30	LF	.31	9.3	.44	13.20	
2" DIA	180	LF	.36	64.8	.60	108.00	
4" DIA	165	LF	.48	79.2	1.80	297.00	
6" DIA	226	LF	.57	128.82	3.44	777.44	
8" DIA	40	LF	.73	29.2	5.13	205.20	
10" DIA	20	LF	.83	16.60	7.75	155.00	
12" DIA	74	LF	.96	71.04	10.67	779.58	
				401.36	2352.02		

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 2 OF 15	
PROJECT					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR FH		CHECKED BY [Signature]			
SUMMARY	QUANTITY		PER UNIT	LABOR M.H.		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.		TOTAL	PER UNIT	TOTAL		
PVC FITTINGS	SCH 80			401.36		2352.02		
90° ELL (SLIP)								
1 1/2" DIA	8	EA	.62	4.96	2.14	17.12		
2" DIA	30	EA	.73	21.90	2.92	27.60		
4" DIA	20	EA	1.33	26.60	15.63	312.60		
6" DIA	24	EA	2.19	52.56	35.65	255.60		
12" DIA	4	EA	4.8	19.20	210.42	257.92		
45° ELL (SLIP)								
2" DIA	10	EA	.73	7.30	2.92	29.20		
4" DIA	12	EA	1.33	15.96	13.22	159.36		
TEE (SLIP)								
2" DIA	10	EA	1.14	11.40	3.39	33.90		
4" DIA	12	EA	2	24.00	25.60	307.20		
6" DIA	9	EA	3.2	28.80	51.23	461.07		
10" DIA	1	EA	4.8	4.80	99.92	99.92		
				621.24		5573.51		

CONSTRUCTION COST ESTIMATE					DATE PREPARED 7-8-82		SHEET 3 OF 15	
PROJECT					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR DK		CHECKED BY [Signature]			
SUMMARY	QUANTITY		LABOR H.H.		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
				621.24		5573.51		
12" DIA	1	EA	6.0	6.00	150.24	150.24		
COUPLINGS (SLIP)								
2" DIA	20	EA	.73	14.60	2.38	47.60		
4" DIA	15	EA	1.33	19.95	9.86	147.90		
6" DIA	20	EA	2.30	46.00	15.37	307.40		
8" DIA	10	EA	3.0	30.0	37.73	226.38		
12" DIA	12	EA	4.0	48.0	29.44	353.28		
REDUCER BUSHING (SPIG X SLIP)								
10" x 8" DIA	3	EA	3.5	10.5	62.21	186.63		
12" x 8" DIA	1	EA	4.00	4.0	132.14	132.14		
12" x 10" DIA	1	EA	4.00	4.0	99.54	99.54		
6" x 4" DIA	6	EA	2.30	13.8	12.20	73.20		
				806.09		7297.82		







CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-7-82		SHEET 7 OF 15	
PROJECT				BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION							
ARCHITECT ENGINEER							
DRAWING NO.			ESTIMATOR FK		CHECKED BY [Signature]		
SUMMARY	QUANTITY		LABOR M.H.		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
				954.39		10463.66	
BUTTERFLY VALVE, IN PVC, WAFFER TYPE WITH METAL HANDLE 4" DIA (+GF #367)	17	EA	2.82	47.94	101.70	1724.98	
DITTO 6" DIA	6	EA	3.3	19.80	161.10	966.60	
BALL VALVE IN PVC, SINGLE UNION, VITON SEAL 1" DIA (GF #345)	6	EA	.35	2.10	23.13	132.78	
DITTO 1 1/2" DIA	6	EA	.40	2.40	37.94	227.64	
SWING CHECK VALVE IN PVC W/ DISC SEAT AND SPRING BALANCED DISC, FLANGED 4" DIA (PPS FIG 0841342)	1	EA	3.25	3.25	550.00	550.00	
				1029.88		14075.58	









CONSTRUCTION COST ESTIMATE					DATE PREPARED <u>7-9-82</u>		SHEET <u>12</u> OF <u>15</u>	
PROJECT					BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION								
ARCHITECT ENGINEER								
DRAWING NO.			ESTIMATOR <u>FK</u>		CHECKED BY <u>Therby</u>			
	SUMMARY	QUANTITY	LABOR H.H.	MATERIAL	TOTAL COST			
		NO. UNITS	UNIT MEAS.	PER UNIT				
					1283.43		37205.53	
PIPE, CARBON STEEL								
SCH 80 SOCKET								
WELDED								
(COMPRESSED AIR SYSTEM)								
2" DIA		60	LF	.26	15.60	4.40	264.00	
VALVES, GLOBE								
BRONZE, SCREWED								
ENDS, 150#								
SERVICE								
2" DIA		3	EA	.73	2.19	80.00	240.00	
VALVES, GATE								
BRONZE, SCREWED								
ENDS, 150#								
2" DIA		2	EA	.73	1.46	42.00	84.00	
					1302.68		37793.53	





CONSTRUCTION COST ESTIMATE				DATE PREPARED 7-12-82		SHEET 15 OF 15	
PROJECT				BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____			
LOCATION							
ARCHITECT ENGINEER							
DRAWING NO.			ESTIMATOR FA		CHECKED BY JMC		
SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SUMMARY:							
PIPING	LABOR			32055.65			
	MATERIAL					43673.53	
PLUMBING							
	LABOR			2886.93			
	MATERIAL					1612.48	
LVAC							
	LABOR			3015.87			
	MATERIAL					4645.90	
EXCAV & BACKFILL							
	LABOR			876.52		—	
SUBTOTAL							
TOTAL							
				38834.97		49931.91	88766.88



<b>CONSTRUCTION COST ESTIMATE</b>				DATE PREPARED <b>7-9-82</b>		SHEET <b>2</b> OF <b>3</b>	
PROJECT <b>NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM</b>						BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____	
LOCATION <b>RMA - COMMERCE CITY, COLO</b>							
ARCHITECT ENGINEER <b>STEARNS-ROGER</b>							
DRAWING NO.				ESTIMATOR <b>W.E.W.</b>		CHECKED BY <b>///</b>	

<u>ELECTRICAL</u> SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<u>LIGHTING FIXTURES</u>							
150 W HPS	6	EA	180	1080	150	900	
COE TYPE WB-1 ENTRY	1	EA	60	60	40	40	
EXIT SIGN W/POWER PACK & REMOTE HEAD	1	EA	53	53	250	250	
COE TYPE R-2D LAV. FIXT.	1	EA	53	53	15	15	
COE TYPE VG-4	1	EA	53	53	45	45	
RECESSED HEAT LAMP FOR LAVATORY	1	EA	60	60	75	75	
<u>DISTRIBUTION</u>				\$1359		\$1325	
20 CKT LTG PNL.	1	EA	600	600	950	950	
10KVA DRY-TYPE TRANS	1	EA	312	312	500	500	
MCC, 3-VERT. SECT.	1	EA	1800	1800	9000	9000	
				\$2712		\$10450	
<u>DEVICES</u>							
SWITCH-BOX-COVER	4	EA	12	48	40	160	
DUPLEX RECP-BOX-COVER	13	EA	14	182	42	546	
				\$230		\$706	
<u>LIGHTNING PROT.</u>							
CADWELDS & MISC.	50	EA			3	150	
CLASS I CONDUCTOR	400	FT		—	1	400	
CU AIR TERMINALS	12	EA		—	5	60	
POINT BASES	12	EA		—	17	204	
CABLE HOLDERS	130	EA		—	2	260	
GROUND RODS	6	EA		—	30	180	
ADHESIVE FOR AIR TERM. & HOLDERS	15	GAL		—	34	510	
CABLE SPLICERS	4	EA		—	6	24	
						\$1788	
<u>LABOR</u>	JOB	120 HRS	24.04	2,885			

<b>CONSTRUCTION COST ESTIMATE</b>				DATE PREPARED <b>7-12-82</b>		SHEET <b>3</b> OF <b>3</b>	
PROJECT <b>NORTHWEST BOUNDARY CONTAINMENT/TREATMENT SYSTEM</b>						BASIS FOR ESTIMATE <input type="checkbox"/> CODE A (No design completed) <input checked="" type="checkbox"/> CODE B (Preliminary design) <input type="checkbox"/> CODE C (Final design) <input type="checkbox"/> OTHER (Specify) _____	
LOCATION <b>RMA - COMMERCE CITY, COLO</b>							
ARCHITECT ENGINEER <b>STEARNS-ROGER</b>							
DRAWING NO.			ESTIMATOR <b>W E W</b>			CHECKED BY <b>94!</b>	

<u>ELECTRICAL</u> SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
<u>GROUND GRID</u>							
#4/0 SDBC CROSS-RUN	200	LF	1.56	312	1.35	270	
#4/0 SDBC PERIM. RUN	300	LF	1.92	576	2.20	660	
BOLTED CONNS. ABOVE GRADE	JOB	<sup>60</sup> HRS	24.04	1442	LS	100	
CADWELD CONNS. & MISC	JOB	<sup>21</sup> HRS	24.04	505	LS	200	
				2835		\$ 1230	
<u>WIRE &amp; CONDUIT</u>							
3" RGS CONDUIT & FITTINGS	100	LF	12	1200	4.50	450	
1 1/2" RGS " "	200	LF	5.75	1150	1.55	310	
1" RGS (TEL. CONDUIT)	60	LF	3.60	216	1.00	60	
3/4" RGS CONDUIT & FITTINGS	1000	LF	3.35	3350	0.80	800	
1" RGS CONDUIT & FITT.	50	LF	3.60	180	1.00	50	
1 1/2" LIQUID TIGHT FLEX	24	LF	7.90	190	5.00	120	
3/4" " "	12	LF	3.60	43	1.90	23	
<u>WIRE, THHN-THWN:</u>							
#6 AWG	800	LF	0.30	240	0.28	224	
#10 AWG	1000	LF	0.22	220	0.12	120	
#12 AWG	1500	LF	0.19	285	0.08	120	
				\$ 7074		\$ 2277	✓
<u>MOTOR &amp; CONTROL</u>							
MOTOR HOOKUP	JOB	<sup>12</sup> HRS	24.04	288		MATERIAL	
CONTROL CKT HOOKUP	JOB	<sup>12</sup> HRS	24.04	288		ABOVE	
				\$ 576			✓



## ARMCO BUILDING SYSTEMS

J. SHELBY WELCH, JR.  
District Manager

July 7, 1982

Stearns Roger Engineering Corporation  
P. O. Box 5888  
Denver, Colorado 80217

Attention: Mr. Steve Van Winkle

Reference: Northwest Boundary Ground Water Control System  
Rocky Mountain Arsenal  
Project No. C26616

Gentlemen:

In accordance with your request, we are pleased to submit for your consideration the following estimate for the above referred to project:

One complete Armco building, type RF-80, size 40'-0" wide x 72'-8" long x 30' high, designed for 30# LL and 25# WL per UBC. The roof panels to be 24 gage ALUMINIZED steel with standing seams and concealed fasteners. The wall panels to be 24 gage galvanized steel with interlocking ribs, concealed fasteners and factory finish color coating with a 20 year warranty. Both endwalls to be designed for future expansion. The following accessories are included:

- 3 - 3070 single swing steel doors with top half glazed and necessary hardware
- 1 - 10' x 14' overhead sectional steel door insulated
- 1 - 12' x 24' overhead sectional steel door insulated
- 1 - 30' length of 12" throat ridge vent with damper and birdscreen
- Gutters and downspouts for both side walls
- Roof insulated with 3" fiberglass blanket to meet U factor of 0.10
- Walls insulated with 3" fiberglass batts to meet U factor of 0.15
- Steelliner to protect insulation up to 8' high around perimeter of building

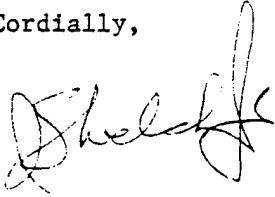
All of the above delivered and erected on foundation by others for the sum of .....\$63,000.00

At the present time and subject to prior orders received, shipment can be made in approximately six weeks.

Stearns Roger Engineering Corporation  
July 7, 1982  
Page 2

We thank you for the opportunity to present this information. Please contact me if you have further questions.

Cordially,

A handwritten signature in dark ink, appearing to be "JSW" with a stylized flourish at the end.

JSW:mp

Enclosures



## ARMCO BUILDING SYSTEMS

J. SHELBY WELCH, JR.  
District Manager

July 8, 1982

*Steve Van Winkle*

REFER TO

NOTE

JUL 09 1982

Gen. Files

ANS'D

Stearns Roger Engineering Corporation  
P. O. Box 5888  
Denver, Colorado 80217

Attention: Mr. Steve Van Winkle

Reference: Northwest Boundary Ground Water Control System  
Rocky Mountain Arsenal  
Project No. C26616

Gentlemen:

Supplementing our letter of July 7, please be advised that to increase the length of building to 77'-8" (3 bays @ 25') the cost would be increased by \$1300.00.

Cordially,

JSW:mp

**QUOTATION**  
**GOULDS PUMPS, INC.**  
**VERTICAL SUMP PUMP**

REPLY TO:  
**PIONEER EQUIPMENT, INC.**  
**P.O. Box 27024**  
**Tucson, AZ 85726**  
**Attn: Dick Cahill**

All quotations subject to terms and conditions on the reverse side and expire unless accepted within 30 days from date of quotation. All quotations subject to change with or without notice.

FORM AR44 EF Sup. 8001E1

To: **Rubel and Hager, Inc.**  
**4400 E. Broadway**  
**Tucson, AZ 85711**

Date: **7/8/82**  
 Proposal No.:  
 Revision No.:

Page:

Attention: **Mr. Frederick Rubel, Jr., P.E.**  
 Inquiry Date: **7/8/82**  
 Inquiry No.: **Rocky Mr. Arsenal**

Copies: **Goulds** **Denver**  
**Pioneer Equip., Phoenix**

Item No.: **P-101,102,103,104.**

*In answer to your inquiry, we propose to furnish GOULDS PUMPS as described below:*

**CONDITIONS OF SERVICE -**

LIQUID Water  
 G.P.M. 500 Sp. Gr. @ 60°F 1.0 PH Value \_\_\_\_\_ Solids % \_\_\_\_\_  
 T.D.H. 162 Sp. Gr. @ P.T. \_\_\_\_\_ Abrasives \_\_\_\_\_ Solids Size \_\_\_\_\_  
 Pumping Temp. \_\_\_\_\_ Visc. @ P.T. \_\_\_\_\_

**PUMP DESCRIPTION -**

QUANTITY 4  
 MODEL 3171  
 Size 3X4-13  
 Group M  
 Pit Type ☒ Wet ☐ Dry  
 Pit Depth 12 fto.  
 Assembly No 22  
 For detailed specifications see Bulletin 726.1

Steady Bearing Lubrication \_\_\_\_\_  
 Support Plate Std.  
 Pit Cover None  
 Case Cast iron  
 Impeller Cast iron  
 Shaft Steel  
 Steady Brngs. Carbon

**CONTROL EQUIPMENT:**

Float Switch = 2  
 Alternator = None  
 Hi Water Alarm = None  
 Single Cont. Voits None  
 Mag. Start Size None  
 NEMA Encl. 4  
 Curve No 1182-3

Efficiency 71.5  
 B.H.P. Rating 28.8  
 Max. B.H.P. 32.3

**IMPELLER DIAMETER:**

Approx. Rating 12.5  
 Min. / Max. 10 / 13

**DRIVER -**

H.P. 40  
 Enclosure 1.15/SF

R.P.M. 1750  
 Insulation B

Phase/Hz 3/60  
 Frame 324

Volts 230/460  
 Furnished by Goulds

**UNIT PRICES -**

PUMP SUPPORT PLATE and COUPLING.....\$ \_\_\_\_\_

Weight, pounds: \_\_\_\_\_

**COMPLETE PRICE EACH**  
**AS DETAILED ABOVE** 5,332.00

1926

DRIVER \_\_\_\_\_  
 FREIGHT (estimated) \_\_\_\_\_  
 TOTAL ~~XXXXXX~~ **QUANTITY FOUR** 21,328.00

TOTAL WEIGHT 7704

PRICES ARE F.O.B. LUBBOCK, TEXAS

Pre-paid job site

SHIPMENT 6-8 weeks after complete engineering and manufacturing information and full approval to proceed with work

TERMS. 30 DAYS NET  
**PER APPROVED CREDIT**

**PIONEER EQUIPMENT, INC.**

*Dick Cahill*  
**Richard J. Cahill**  
**Sales Representative**

FILTEMP SALES, INC.

filtration • flow • heat • control

243-4245

S-101 A,B

S-102 A,B

S-103 A,B

MAILING ADDRESS:  
P.O. BOX 15173  
PHOENIX, ARIZONA 85060

OFFICE:  
3601 S. 42ND STREET  
PHOENIX, ARIZONA 85040

July 8, 1982

RECEIVED

JUL 12 1982

RUBEL & HAGER, INC.

Rubel & Hager  
4400 E. Broadway, Suite 602  
Tucson, Arizona 85711

Attention: Mr. Fred Rubel

Reference: Rocky Mountain Arsenal  
Northwest Boundary Treatment System

Dear Mr. Rubel:

We are pleased to quote the following Filterite Equipment per your request.

A      Qty

6      Filterite Model 66MS03-316-4FD-C150  
Code Vessel - 316SS - 150 # Operating Pressure  
1" NPT Vent - 1 1/2 " NPT Drain - 316SS  
Top Seat Plate & Springs - Ethylene Propylene  
Gasket - "UM" stamp standard - includes eye nuts -  
Houses 22-30" cartridges - See Bulletin 1762.

Price each: \$4,550.00  
Qty--6 at: \$ 27,300.00  
Est Frt - Total: \$580.00  
6 Sets of Cart (U100AW30U) : \$800.00

Total Cost: \$28,680.00

B

Option B same as item A except Vessel is 304SS instead of 316SS.

Price each: \$3,761.00  
Qty--6 at: \$22,566.00  
Est Frt - Total: \$580.00  
6 Sets of Cart (U100AU30U) : \$800.00

Total Cost: \$23,946.00

C

Replacement Cartridges

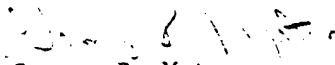
Filterite U100AW30U  
100 Micron - 30" length - Polypropylene  
Core and Polypropylene Wind

July 8, 1982  
Rubel & Hager  
Page 2

Lot Price, 150 Cart : \$975.00  
F.O.B. Phoenix

Both Item A and Item B include non code stamp at no additional charge.  
If you require "U" stamp then please add \$250.00 to total cost. In my  
opinion the "UM" stamp is more than sufficient. Please contact our  
office if we can provide further information.

Sincerely,

  
George R. Metro  
Filtemp Sales, Inc.

nam

ADSORPTION SYSTEM EQUIPMENT

**Westvaco**

July 9, 1982

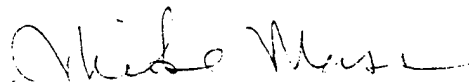
Mr. Fred Rubel  
Rubel & Hager, Inc.  
4400 E. Broadway, Suite 602  
Tucson, AZ 85711

Dear Fred:

In accordance with your request, I have enclosed a proposal for a Westvaco Pulsed Bed Adsorption System for the Northwest Boundary Containment Treatment Facility, Rocky Mountain Arsenal. Included is a budget estimate of the uninstalled cost of this equipment.

If you require further information or details, please contact me.

Sincerely yours,



Michael L. Massey, Ph.D., P.E.  
Manager, Carbon Systems

MLM/sa  
Enclosure

**Chemical Division**  
Carbon Department  
Covington, Virginia 24426  
Telephone: 703-962-1121

PROPOSAL FOR A  
WESTVACO PULSED BED ADSORPTION SYSTEM

PROVIDED BY  
WESTVACO CORPORATION  
CARBON DEPARTMENT  
CARBON SYSTEMS GROUP  
COVINGTON, VIRGINIA 24426

FOR  
ROCKY MOUNTAIN ARSENAL  
NW BOUNDARY TREATMENT SYSTEM  
COMMERCE CITY, COLORADO

JULY 9, 1982

## Introduction

Westvaco has been requested to prepare a proposal, including budget estimate, for a Westvaco Pulsed Bed Adsorption System. This system will provide carbon adsorption treatment of groundwater at the proposed NW Boundary project at Rocky Mountain Arsenal, Commerce City, CO.

The treatment process will consist of the following:

- A. Three standard pulsed bed adsorption columns.
- B. Two carbon storage tanks, one for fresh carbon and one for spent carbon.
- C. A dual blowcase assembly for carbon transport.
- D. 150,000 pounds of virgin carbon, Nuchar WV-G.

The price covers the cost of delivery of assembled treatment modules as described in the process description. It does not cover the cost of on-site installation. Details of the proposed system are as follows:

## Process Description

The Westvaco Pulsed Bed Adsorption System shall include the following standard Westvaco components as required by the specifications:

- A. Adsorption Unit
  - 1. The carbon adsorption system shall be three upflow Pulsed Bed Systems as manufactured by Westvaco.
  - 2. Each 42,000 lb contactor unit shall be a ten-foot diameter 1400 cu ft capacity ASME 50 psig Design Pressure Vessel with potable water lining.
  - 3. Influent and effluent connections shall be designed to insure even flow distribution.

4. Each adsorber shall be mounted on a support structure designed to support the contactor and all piping and attached equipment under all operating conditions. The support structure shall be designed to provide ready access to piping and valves.
5. Connections to each adsorber shall be as follows:
  - a. Raw water inlet and treated water outlets shall be four 6-inch connections.
  - b. Fresh carbon inlet and spent carbon outlet connections shall be 2-inch and properly designed to facilitate carbon handling.
  - c. Three 1/2-inch 316SS sample nozzles are to be spaced at the quarter points of the adsorber, with the nozzle penetrating 6 inches into the carbon bed.
6. Each adsorber shall be furnished with two 20-inch diameter manholes--one manhole to be located on the top of the vessel and the other on the side near the bottom of the vessel. An access ladder in conformance with applicable safety standards shall be provided for the top manhole.

B. Fresh Carbon Storage Tank

1. One ten-foot diameter 740 cu ft capacity fresh carbon storage tank shall be provided. The tank will be an open top cone-bottom vessel suitable for storing a minimum of 20,000 lb (dry weight) of spent carbon. A full water level will be maintained in the tank by a float valve.
2. The tank shall be of all-welded carbon steel construction with potable water lining.
3. The structure and baseplate shall be designed to support the tank, tank contents, and attached equipment under all operating conditions. Lugs, adequate for all lifting and moving the tank, shall be provided.

4. Connections to the fresh carbon storage tank shall be as follows:
  - a. The bottom carbon outlet shall be 4-inch diameter (minimum)
  - b. A 2-inch diameter raw water connection
  - c. The tank overflow shall be 4-inch diameter and shall be located above the normal liquid level. The outlet shall be screened to prevent loss of activated carbon.

C. Spent Carbon Storage Tank

1. One ten-foot diameter 740 cu ft capacity spent carbon storage tank shall be provided. The tank will be an open top cone bottom vessel suitable for storing a minimum of 20,000 lb (dry weight) of spent carbon. A full water level will be maintained in the tank by a float valve. Removal of spent carbon will be by the use of an eductor.
2. The tank shall be all-welded carbon steel construction with potable water lining.
3. The structure and baseplate shall be designed to support the tank, tank contents, and attached equipment under all operating conditions. Lugs, adequate for all lifting and moving of the tank, shall be provided.
4. Connections to the spent carbon storage tank shall be as follows:
  - a. The bottom carbon outlet shall be 4-inch diameter (minimum)
  - b. A 4-inch diameter raw water connection
  - c. The tank overflow shall be 4-inch diameter and shall be located above the normal liquid level. The outlet shall be screened to prevent loss of activated carbon.

D. Carbon Transport System

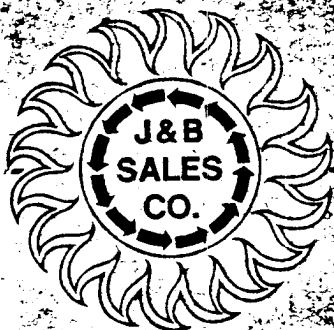
1. The carbon transport system shall consist of separate fresh and spent carbon blowcases to transfer carbon slurry from the fresh carbon storage tank to each adsorber unit and from each adsorber unit to the spent carbon storage tank. Carbon transport will be by air pressurization and eductors. Normal pulsing operation will consist of transporting 2,000 lb of dry carbon per cycle.
2. The blowcases shall be 70 cu ft capacity ASME 50 psig Design Pressure Vessels. All wetted parts of the vessels shall be 316 L stainless steel. The pressure vessels shall be stamped in compliance with ASME Code.
3. A common support structure and baseplate shall be provided for the two blowcases. The support structure and baseplate shall be designed to support the blowcases, contents, and all attached piping and appurtenances under all operating conditions. The support structure shall be carbon steel. Lifting lugs, adequate for all lifting and moving of the blowcases, shall be provided.
4. Each blowcase shall be provided with a 16-inch diameter quick-opening, hinged manhole for top access and observation. An access ladder and platform, designed in conformance with applicable safety standards, shall be provided.

E. Granular Activated Carbon

Westvaco shall supply and install an initial inventory of 150,000 lb of virgin granular activated carbon. The initial carbon supply shall be Westvaco Nuchar WV-G.

Price

The estimated cost for the equipment as described in this proposal is \$638,000, FOB job site.



QUOTATION

**J & B SALES CO.**

3441 N. 29th AVE • PHOENIX, ARIZONA 85017

TELEPHONE 602 • 258-1545

JOB Rocky Mountain Arsenal

Page 1 of 1

N.N. Boundry Treatment System

Arch. Rubel &amp; Hager

**P-105**

Eng. Rubel &amp; Hager

Quote No. 2106

Date 7-8-82

Due 7-9-82

Quan.

Description

Net Price

To: Rubel & Hager, Inc.  
4400 E. Broadway Suite 602  
Tucson, AZ 85711

Attn: Mr. Fred Rubel

1 Bell & Gossett Model 1531 - 2AC Close Coupled Pump  
Duty: 175 gpm @ 175' TDH 5,200' Elev.  
15 HP 460/3/60 3500 rpm ODP Motor

Total Price FOB Factory, FFA Commerce City, Colorado. . \$1,600.00

**RECEIVED**

JUL 9 1982

**RUBEL & HAGER, INC.**

Above Prices Are Full Freight Allowed Unless Otherwise Stated.  
Starters, Vibration Bases & Accessories Are Not Included Unless Listed.  
Quotation Automatically Expires Thirty (30) Calendar Days From The Date Issued.

# QUOTATION

**ALBANY**  
INTERNATIONAL

Engineered Systems  
Division

P.O. BOX 310, QUAKER RD., GLENS FALLS, N.Y. 12801/TEL. 518-793-8801/TELEX 145339

Mr. Fred Rubel  
RUBEL & HAGER  
4400 East Broadway  
Suite 602  
Tucson, AZ 85711

July 8, 1982

Quotation Number: Q82-041T

S-104

QTY.	UNIT PRICE	TOTAL
1	AES Model 5250S20A2 Multiple Filter with external backwash	70,133.00
	Application: Granular Activated Carbon Pressure Rating: 25 psi (operating pressure) Flow: 1500 gpm Fabrication: 316 stainless steel Construction: 20 barrels; assembled and mounted on a mild steel frame. Inlet/Outlet Header Size: 12" flanged External Backwash Header: 2" threaded Drain Size: 2-1/2" threaded Media: .003" wedge wire Valve Size & Seats: 2" Teflon Seals: EPDM Gauges: 0-400 psi Filter Media Area: 8160 sq. inches Backwash Automation (Time Clock and Differential Pressure Switch)	
	<u>Option:</u>	
	Service Step	500.00
	Reference Drawing: D-10640	

WARRANTY: ALBANY ENGINEERED SYSTEMS WARRANTS ALL AES PRODUCTS AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP IN NORMAL USE FOR ONE YEAR FROM DATE OF SHIPMENT, SUCH WARRANTY BEING LIMITED TO REPLACEMENT OR REPAIR OF DEFECTIVE PARTS AT OUR DISCRETION. WE HAVE NO LIABILITY FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED. THERE ARE NO OTHER WARRANTIES EXCEPT AS SET FORTH ABOVE.

CUSTOMER'S COPY

# QUOTATION

**ALBANY**  
**INTERNATIONAL**  
Engineered Systems  
Division

P.O. BOX 310, QUAKER RD., GLENS FALLS, N.Y. 12801/TEL. 518-793-8801/TELEX 145339

Page Two

Quotation Number: Q82-041T

**MANUALS :** Two operating manuals supplied with purchase of this equipment. Additional manuals \$15 each. Reproducibles of drawings (sepias or microfile aperture cards) available at \$5 each.

**START-UP**

**SERVICE :** For the AES Products as outlined in this quotation, no charge service will be provided as follows:

Field Service Technician: Two Days  
Applications Engineer : Two Days

The customer has the option of assigning this no charge service time for Training Sessions, Installation Inspection or Start-Up Assistance. Should additional service be required, the following rates apply:

Field Service Technician @ \$220 per day  
Applications Engineer @ \$350 per day

When service is scheduled by the customer with less than one week's notice, travel expenses will be charged at cost. A Purchase Order must be issued to cover the additional service requirements beyond the allocation as stated above.

**VALIDITY:** The prices quoted are firm for order placement 60 days from the date of this quotation for delivery not to exceed six (6) months from date of order issuance.

**WARRANTY:** ALBANY ENGINEERED SYSTEMS WARRANTS ALL AES PRODUCTS AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP IN NORMAL USE FOR ONE YEAR FROM DATE OF SHIPMENT. SUCH WARRANTY BEING LIMITED TO REPLACEMENT OR REPAIR OF DEFECTIVE PARTS AT OUR DISCRETION. WE HAVE NO LIABILITY FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED. THERE ARE NO OTHER WARRANTIES EXCEPT AS SET FORTH ABOVE.

CUSTOMER'S COPY

# QUOTATION

**ALBANY**  
**INTERNATIONAL**

Engineered Systems  
Division

P.O. BOX 310, QUAKER RD., GLENS FALLS, N.Y. 12801/TEL. 518-793-8801/TELEX 145339

Page Three

Quotation Number: Q82-041T

**SHIPMENT:** After receipt of order and full customer approved technical data enabling us to proceed with engineering and manufacturing, our delivery schedule for the equipment specified in this quotation is detailed below. Any delay in our receipt of customer approved technical data may adversely affect the delivery date.

**FOB:** Denver, Co - 12-14 weeks

**TERMS :** 25% with prints for customer approval - Net 30 days.  
75% at shipment - Net 30 days.

**ACCEPTANCE:** Orders are subject to acceptance at Glens Falls, NY.

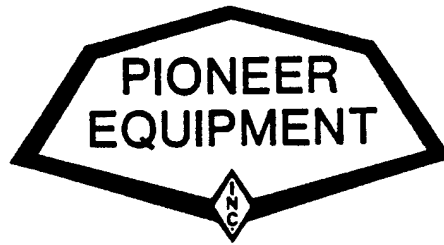
By: Peg Campbell  
Customer Service

**WARRANTY:** ALBANY ENGINEERED SYSTEMS WARRANTS ALL AES PRODUCTS AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP IN NORMAL USE FOR ONE YEAR FROM DATE OF SHIPMENT. SUCH WARRANTY BEING LIMITED TO REPLACEMENT OR REPAIR OF DEFECTIVE PARTS AT OUR DISCRETION. WE HAVE NO LIABILITY FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED. THERE ARE NO OTHER WARRANTIES EXCEPT AS SET FORTH ABOVE.

CUSTOMER'S COPY

PROPOSAL

☐ P.O. Box 6753  
Phoenix, Arizona 85005-6573  
(602) 269-1323



☒ P.O. Box 27024  
Tucson, Arizona 85726-7024  
(602) 792-3255

FORMERLY AIR COMPRESSOR SERVICE

TO: Rubel and Hager, Inc.

DATE July 8, 1982

This proposal effective for 30 Days.

Attn: Mr. Frederick Rubel, Jr., P.E.

Gentlemen: We are pleased to quote on the following equipment:

C-101

QUAN.	DESCRIPTION	UNIT PRICE	AMOUNT
ONE	<p>INGERSOLL-RAND COMPRESSOR PACKAGE, MODEL 7E3, COMPLETE</p> <p>WITH THE FOLLOWING MAJOR COMPONENTS:</p> <ul style="list-style-type: none"> <li>a) BARE COMPRESSOR #253</li> <li>b) 7½ H.P. NEMA 3 PHASE 230/460 V MOTOR</li> <li>c) 120 GAL. ASME RECEIVER TANK</li> <li>d) PRE-WIRED AND MOUNTED MAGNETIC STARTER</li> <li>e) AIR COOLED INTERCOOLER</li> <li>f) ENCLOSED BELT GUARD</li> <li>g) AUTO/START/STOP CONTROL</li> <li>h) SAFETY SERVICE AND DRAIN VALVE.</li> </ul> <p><u>PERFORMANCE DATA</u></p> <ul style="list-style-type: none"> <li>a) 26.2 CFM PISTON DISPLACEMENT</li> <li>b) 20.3 CFM @ 100 PSI</li> <li>c) COMPRESSOR RPM - 660.</li> </ul> <p>TOTAL NET PRICE.....</p> <p>All Applicable Taxes to Apply</p>		2,800.00

F.O.B. Delivered Job Site

Delivery One week

Terms Net 30 days

**PIONEER EQUIPMENT, INC.**

BY Dick Cahill

This quotation not valid unless signed

Prices quoted are subject to adjustment to price in effect at time of shipment.

Warranty is limited to that on new machines as furnished by Manufacturers or as otherwise stated herein.

All items quoted herein are subject to prior sale or other disposition.

All orders taken which require financing are subject to the approval of our credit department or that of the financing institution.

Delivery date given on this order is contingent upon promised shipment from our suppliers and upon government restrictions or other factors beyond our control.

The above proposal is hereby accepted as outlined:

Customer \_\_\_\_\_

BY \_\_\_\_\_

Northwest Boundary Containment Treatment Facility  
Rocky Mountain Arsenal, Commerce City, Colorado  
Stearns-Roger Subcontract No. 7000 C26616

Process Design Calculations

Prepared by: D. G. Hager *DGH*

Checked by: F. Rubel, Jr. *FRJ*

I. Sizing of Liquid Phase Adsorption Vessels

A. Design Criteria

- 1) Superficial residence (empty bed) time required in upflow packed granular activated carbon bed for removal of 0.8 µg/l excess DBCP from potable water - 15 minutes minimum.
- 2) Raw water flow rate - 1500 gpm maximum.
- 3) Standard Westvaco Pulse Bed Adsorber volume - 1400 ft.<sup>3</sup>.

B. Calculations

- 1)a. Try two (2) standard Pulse Bed Adsorbers -  
Volume = 2 x 1400 ft<sup>3</sup> = 2800 ft<sup>3</sup> = 21,000 gallons  
Superficial Residence Time =  $\frac{21,000 \text{ gallons}}{1500 \text{ gpm}} =$   
14 minutes < 15 minutes. ∴ NG
- b. Try three (3) standard Pulse Bed Adsorbers -  
Volume = 3 x 1400 ft<sup>3</sup> = 4200 ft<sup>3</sup> = 31,500 gallons  
Superficial Residence Time =  $\frac{31,500 \text{ gallons}}{1500 \text{ gpm}} =$   
21 minutes > 15 minutes. ∴ OK  
Use Three (3) standard Pulse Bed Adsorbers

2) Flow rate per adsorber

$$\frac{1500 \text{ gpm}}{3 \text{ adsorbers}} = 500 \text{ gpm/adsorber}$$

II. Process Pipe Sizing

A. Design Criteria

- 1) Pipe material - schedule 80 Type I PVC
- 2) Flow rate per treatment branch (train) = <500 gpm
- 3) Raw water velocity  $\leq 8.0$  ft/sec
- 4) Treated water velocity  $\leq 5.0$  ft/sec
- 5) Slurry Flush/Eductor/Backwash water velocity  $\leq 8.0$  ft/sec

B. Calculations

- 1) Raw water pipe size (identical piping for each train)

- a) Try 4", v = 8.99 ft/sec > 8.0 ft/sec  $\therefore$  NG
- b) Try 6", v = 6.27 ft/sec < 8.0 ft/sec  $\therefore$  OK

Use 6" Schedule 80 Type I PVC Pipe and Fittings for Raw Water.

- 2) Treated water pipe size - Effluent from one adsorber

- a) Try 6", v = 6.27 ft/sec > 5.0 ft/sec  $\therefore$  NG
- b) Try 8", v = 3.57 ft/sec < 5.0 ft/sec  $\therefore$  OK

Use 8" Schedule 80 Type I PVC Pipe and Fittings for Effluent from one Adsorber.

- 3) Treated water pipe size - Effluent from two adsorbers

- a) Try 8", v = 7.14 ft/sec > 5.0 ft/sec  $\therefore$  NG
- b) Try 10", v = 4.54 ft/sec < 5.0 ft/sec  $\therefore$  OK

Use 10" Schedule 80 Type I PVC Pipe and Fittings for Effluent from two Adsorbers.

- 4) Treated water pipe size - Effluent from three adsorbers

- a) Try 10", v = 6.80 ft/sec > 5.0 ft/sec  $\therefore$  NG
- b) Try 12", v = 4.81 ft/sec < 5.0 ft/sec  $\therefore$  OK

Use 12" Schedule 80 Type I PVC Pipe and Fittings for Effluent from three Adsorbers.

5) Slurry Flush/Eductor/Backwash water pipe size

- a) Try 3",  $v = 8.72 \text{ ft/sec} > 8.0 \text{ ft/sec} \therefore \text{NG}$
- b) Try 4",  $v = 5.02 \text{ ft/sec} < 5.0 \text{ ft/sec} \therefore \text{OK}$

Use 4" Schedule 80 Type I PVC Pipe and Fittings  
for Slurry Flush/Eductor/Backwash Water System.

III. Carbon Slurry Transfer Pipe Sizing

A. Criteria

- 1. Carbon Slurry Transfer to and from Carbon Transport Trailer - 4" Polypropylene lined Carbon Steel (flanged) Pipe
- 2. Carbon Slurry Transfer to and from Carbon Blowcases - 2" Polypropylene lined Carbon Steel (flanged) Pipe
- 3. Carbon Slurry Velocity = 5 ft/sec
- 4. Dry carbon density = 30 lb/ft<sup>3</sup>

B. Calculations

- 1. Time to transfer 20,000 lbs. granular activated carbon truckload to or from Carbon Transport Trailer

Pipe inside diameter = 3.612 in., Area = 10.25 in.<sup>2</sup> = .0712 ft<sup>2</sup>

@ velocity = 5 ft/sec Volume = 0.3558 ft<sup>3</sup>/sec = 21.35 ft<sup>3</sup>/min = 640 lb/min

Transfer Time =  $\frac{20,000 \text{ lbs.}}{640 \text{ lbs/min}} = \underline{\underline{31.3 \text{ minutes}}}$

- 2. Time to transfer 2,000 lb. granular activated Carbon Pulse to and from Carbon Blowcases

Pipe inside diameter = 1.723 in., Area = 2.35 in.<sup>2</sup> = .0164 ft<sup>2</sup>

@ velocity = 5 ft/sec Volume = 0.0818 ft<sup>3</sup>/sec = 4.91 ft<sup>3</sup>/min = 147 lbs/min

Transfer Time =  $\frac{2,000 \text{ lbs.}}{147 \text{ lbs/min}} = \underline{\underline{13.6 \text{ minutes}}}$

IV. Process Water Pressure Drop through each Treatment Train

A. Criteria

1. Since the piping design has not been accomplished at this time, a pressure drop calculation based upon conservative assumptions is provided.
2. Flow rate 500 gpm through 6" and 8" Pipe; head loss per 100' is 0.87 and 0.22 psig respectively.
3. Flow rate 1500 gpm through 12" Pipe; head loss per 100' = 0.24 psig.

B. Calculations

1. Pressure Drop through Pipe and Fittings

	Equivalent Pipe Length	$\Delta P$
a) 80'-6" Sch. 80 PVC Pipe	80	2.3
b) 3 -6" Sch.80 PVC Tee @ 32.2'	96.6	
c) 6 -6" Sch.80 PVC 90° Ell @15.2'	91.2	
d) 40'-8" Sch.80 PVC Pipe	40	0.4
e) 1 -8" Sch.80 PVC Tee @39.9	39.9	
f) 4 -8" Sch.80 PVC 90° Ell @20'	80	
g) 40'-12" Sch.80 PVC Pipe	40	0.3
h) 3 -12" Sch.80 PVC 80° Ell @ 30	90	
		3.0 psig

2. Pressure Drop Through Valves and Flow Controller

a) 1-6" Check Valve @ 0.1 psig@	0.1
b) 3-6: Butterfly Valves @ 0.3 psig@	0.9
c) 1- Rate of Flow Controller @ 7.0 psig (max.)	9.0
	10.0 psig

3. Pressure Drop Through Adsorber and Filter Modules (pressure drop will build up in each of these modules until a maximum is reached at which time backwash or cartridge change will significantly decrease the pressure drop).

	<u><math>\Delta P</math></u>
a) Prefilter Module - 15 psi (max.)	15.0
b) Pulse Bed Adsorber Module - 25 psi (max.)	25.0
c) Post filter Module - 10 psi (max.)	<u>10.0</u>
	50.0 psig
4. Gravity head - 12 ft.	5.2 psig
5. Velocity head	0.3 psig
6. Total $\Delta P$ (1 through 5 above)	<u>68.5 psig</u>

# Stearns-Roger

PAGE

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JOB NO. 26616 DATE 7-2-82 BY GLW CH'K \_\_\_\_\_  
CUSTOMER R N A PROJECT GROUND WATER TREATMENT  
SUBJECT DESIGN LOADS STRUCTURAL

## BUILDING LOADS

## PRELIMINARY DESIGN.

Roof DEAD LOAD = 20 psf  
LIVE LOAD OR } = 30 psf = (0.8 x 35 psf)  
SNOW LOAD } ANSI 7.2.1

CONTINGENCY LOAD AT MD SPAN = SAY 5.0 K.

WALL LOAD = 5 psf

WIND LOAD = 24 psf ANSI Exposure 'C'  
80 MPH.

## SEISMIC

ZONE 1

SOIL BEARING PRESSURE 3000 psf.

## EQUIPMENT LOADS

ABSORBERS = 140,000 LBS EACH  
DUAL BLOW CASE = 20,000 LBS  
STORAGE MODULE = 75,000 LBS EACH  
PRE FILTERS =  
POST FILTER =  
PUMPS =

ACCESS WALKWAY DEAD LOAD = 25 psf  
LIVE LOAD = 100 psf

ALLOW FOR EQUIPMENT PADS TO BE  
4" ABOVE FINISHED FLOOR LEVEL WITH  
ALLOWANCE OF GROUT FOR LEVELLING.

FOUNDATION DEPTHS TO BELOW FROST LINE  
OF 3'-6"

AEIM 9. 1/81.

# Stearns-Roger

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JOB NO. 26616 DATE 7-2-82 BY glw CH'K.  
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT  
SUBJECT FOUNDATION LOADS FROM BUILDING

CENTER COL.

TRIBUTARY WIDTH 25'-0" SPAN 40'-0"  
HEIGHT 30'-0"

Roof  $DL = 20 \times 25'-0" = 0.5^k/ft$   
 $LL = 30 \times 25'-0" = 0.75^k/ft$   
 $1.25^k/ft$

REACTION AT COL. =  $1.25 \times \frac{40}{2} = 25.0^k$   
 $5.0^k$  CONTINGENCY +  $2.5^k$   
Roof TOTAL / COL =  $27.5^k$

LOAD FROM SIDING =  $5 \times 25 \times 30'-0" = 3.75^k$

TOTAL VERTICAL AT BASE =  $31.25^k$

END COLS WILL BE  $\frac{1}{2}$  THIS LOAD  
PLUS VERTICAL END WALL LOAD

$= 31.25/2 + 5 \times 14 \times 30 = 17.73^k$

WIND LOAD ON SIDE WALL  
 $= 24 \times 25'-0" = 0.6^k/ft$  CENTER COL  
 $0.3^k/ft$  END COL

By INSPECTION WIND WILL CONTROL  
BUILDING DESIGN AND SEISMIC WILL  
CONTROL FOUNDATIONS FOR INTERIOR  
VESSELS.

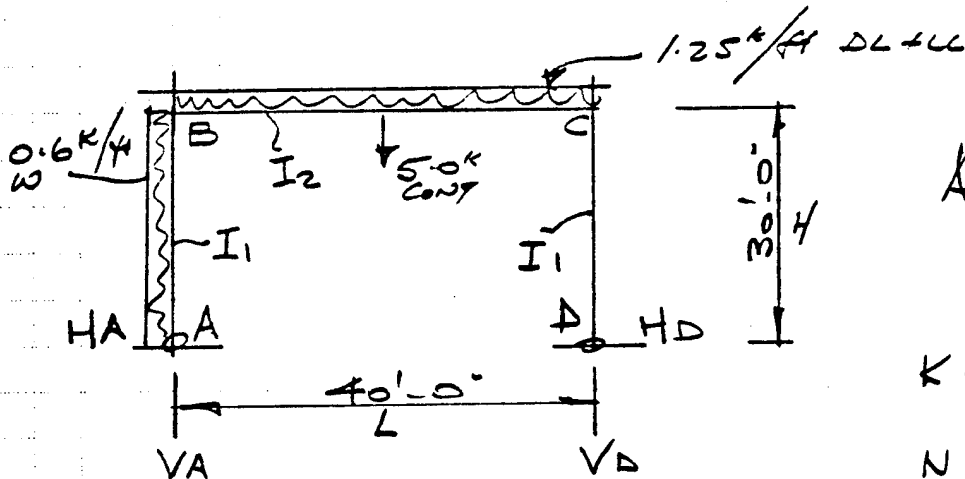
# Stearns-Roger

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JOB NO. 26616 DATE 7-2-82 BY GLW CH'K. \_\_\_\_\_  
CUSTOMER RMA PROJECT GROUND WATER TREATMENT  
SUBJECT FOUNDATION LOADS FROM BUILDING

FROM STEEL DESIGNERS MANUAL BY UNGER  
USE FRAME TYPE II (pg 291).



Assume  $I_1$  &  $I_2$   
= 1.0

$$K = \frac{I_2}{I_1} \times \frac{30}{40} = 0.75$$

$$N = 2K + 3 = 4.75$$

Roof DL+LL

$$M_B = M_C = \frac{1.25 \times 40^2}{4 \times 4.75} = -105.26 \text{ K-ft}$$

$$V_A = V_D = \frac{wL}{2} = +25.0 \text{ K}$$

$$H_A = H_D = -\frac{105.26}{30} = -3.5 \text{ K}$$

WIND

$$M_B = \frac{0.6 \times 30^2}{4} \left[ -\frac{0.75}{2 \times 4.75} + 1 \right] = +124.2 \text{ K-ft}$$

$$M_C = \frac{0.6 \times 30^2}{4} \left[ -\frac{0.75}{2 \times 4.75} - 1 \right] = -145.8 \text{ K-ft}$$

$$H_D = -\frac{M_C}{H} = -\frac{-145.8}{30} = +4.86 \text{ K}$$

$$H_A = -(0.6 \times 30 - 4.86) = +13.14 \text{ K}$$

$$V_A = V_D = -\frac{0.6 \times 30^2}{2L} = V_A = -6.75 \text{ K} \quad V_D = +6.75 \text{ K}$$

# Stearns-Roger

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JOE NO. 26616 DATE 7-2-82 BY gfw CHK.   
CUSTOMER RMA PROJECT GROUND WATER TREATMENT  
SUBJECT FOUNDATION LOADS FROM BUILDING.

5.0K CONTINGENCY LOAD.

$$M_B = M_C = - \frac{3 \times 5 \times 40}{8 \times 4.75} = -15.8 \text{ Kft}$$

$$V_A = V_D = \frac{5}{2} = +2.5 \text{ K}$$

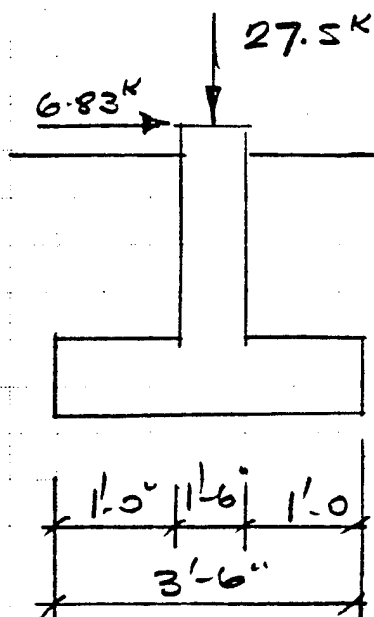
$$H_A = H_D = - \frac{15.8}{30} = -0.53 \text{ K}$$

TOTAL LOADS

LOAD	M <sub>B</sub>	M <sub>C</sub>	V <sub>A</sub>	V <sub>D</sub>	H <sub>A</sub>	H <sub>D</sub>
DL+LL	-105.26	-105.26	+25.0	+25.0	-3.5	-3.5
WIND	+124.2	-148.8	-6.75	+6.75	-4.86	+13.14
5.0K.	-15.8	-15.8	+2.5	+2.5	-0.53	-0.53
DL+LL+5.0	-121.06	-121.06	+27.5	+27.5	-4.03	-4.03
WITH WIND AT 0.75	2.36 <sup>K</sup>	200 <sup>K</sup>	+15.56 <sup>K</sup>	+25.69 <sup>K</sup>	-6.67 <sup>K</sup>	+6.83 <sup>K</sup>

# Stearns-Roger

JOE NO. 26616 DATE 7-2-82 BY glw CH'K. 5  
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT  
SUBJECT BUILDING FOUNDATIONS



Worst Case

$$\text{Try Base } 3'-6 \times 3'-6 \\ = 12.25 \text{ sq ft}$$

$$\begin{aligned} \text{PIER} &= 1.5 \times 1.5 \times 3 \times 0.15 = 1.0125 \times 1.75 = 1.77 \\ \text{SLAB} &= 3.5 \times 3.5 \times 1.0 \times 0.15 = 1.8375 \times 1.75 = 3.22 \\ \text{SOIL} &= (3.5^2 - 1.5^2) \times 2.5 \times 0.1 = 2.5 \times 1.75 = 4.375 \\ P &= \frac{27.5}{32.85} \times 1.75 = 48.125 \\ \Sigma W &= 57.49 \text{ k} \end{aligned}$$

$$M_{OT} = 6.83 \times 4.0 = 27.32 \text{ k ft}$$

$$\bar{X} = \frac{57.49 - 27.32}{32.85} = 0.918 \text{ ft} < 1.17$$

$$e = \frac{3.5}{2} - 0.918 = 0.832 \text{ ft}$$

$$I = \frac{3.5 \times 3.5^3}{12} = 12.5 \text{ ins}^4$$

$$\begin{aligned} P &= \frac{32.85}{12.25} + \frac{32.85 \times 0.832 \times 1.75}{12.5} \\ &= 2.68 \pm 3.826 > 3 \text{ ksf} \end{aligned}$$

Try 5'-0" Square

# Stearns-Roger

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JOB NO. 26616 DATE 7-2-82 BY GFW CH'K.   
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT  
SUBJECT BUILDING FOUNDATIONS

$$\begin{aligned} \text{PIER} &= 1.5 \times 1.5 \times 3 \times 0.15 = 1.0125 \times 2.5 = 2.53 \\ \text{SLAB} &= 5.0 \times 5.0 \times 1.0 \times 0.15 = 3.75 \times 2.5 = 9.375 \\ \text{SOIL} &= (5.0^2 - 1.5^2) \times 3 \times 0.1 = 6.825 \times 2.5 = 17.063 \\ P &= \frac{27.5}{2.5} = 11.0 \\ \Sigma W &= 39.1 \text{ K} \quad \Sigma MR = 97.72 \text{ Kft} \end{aligned}$$

$$M_{OT} = 6.83 \times 4 = 27.32 \text{ Kft}$$

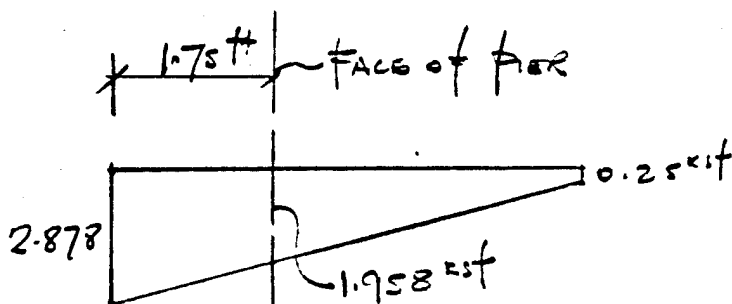
$$\bar{X} = \frac{97.72 - 27.32}{39.1} = 1.8 \text{ ft}$$

$$e = \frac{5.0}{2} - 1.8 = 0.7 \text{ ft}$$

$$I = \frac{5.0 \times 5.0^3}{12} = 52.08 \text{ in}^4$$

$$P = \frac{39.1}{25.0} \pm \frac{39.1 \times 0.7 \times 2.5}{52.08}$$

$$= 1.564 \pm 1.314 = +2.878 \text{ Ksf} < 3.0 \\ + 0.25 \text{ Ksf}$$



$$\begin{aligned} \text{Bnl @ Face of Pier} &= \frac{1.958 \times 1.75^2}{2} + \frac{0.92 \times 1.75^2}{2} \\ &= 3.0 + 1.0 = 4.0 \text{ Kft} \end{aligned}$$

$$A_s = \frac{M}{a d} = \frac{4.0}{1.76 \times 9} = 0.25 \text{ in}^2$$

$$\text{Min } A_s = 12 \times 12 \times 0.002 = 0.288 \text{ in}^2$$

USE #5 @ 12" CTS BOTH WAYS IN SLAB.

# Stearns-Roger

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JOB NO. 26616 DATE 7-6-82 BY g/w CHK.  
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT  
SUBJECT BUILDING FOUNDATIONS

PIER REINFORCING.

$$BM = 6.83 \times 3.0 = 20.49 \text{ Kft}$$

$$As = \frac{20.49}{1.76 \times 13.5} = 0.862 \text{ in}^2$$

USE 2-#6  $As = 0.88 \text{ in}^2$

SO USE 4-#6 IN PIERS WITH  
#3 TIES AT 12" CENTERS.

CORNER COLS WILL HAVE  $\frac{1}{2}$  ROOF LOAD &  $\frac{1}{2}$  WIND LOAD. BUT WILL HAVE ADDITIONAL SIDING LOAD.

$$\text{SO HORIZONTAL FROM WIND} = 6.83/2 = \underline{3.42 \text{ K}}$$

$$\text{VERTICAL: SIDING} = 10 \times 5 \times 30 = 1.5 \text{ K}$$

$$+ 3.75/2 = 1.875 \text{ K}$$

$$\text{FROM ROOF} = 25.0/2 = 12.5 \text{ K}$$

$$+ 5.0 \text{ K CONTINGENCY} = 5.0$$

$$\underline{20.875 \text{ K TOTAL VERT}}$$

$$\text{SAY } \underline{21.0 \text{ K}}$$

TRY 3'-6" Sq BASE (PG 5)

$$\text{PIER} = 1.5 \times 1.5 \times 3 \times 0.15 = 1.0125 \times 1.75 = 1.77$$

$$\text{SLAB} = 3.5 \times 3.5 \times 1.0 \times 0.15 = 1.8375 \times 1.75 = 3.22$$

$$\text{SOIL} = (3.5^2 - 1.5^2) \times 2.5 \times 0.1 = 2.5 \times 1.75 = 4.375$$

$$P = \underline{21.0} \times 1.75 = \underline{36.75}$$

$$\underline{\Sigma W = 26.38 \text{ K}}$$

$$\underline{\Sigma M = 46.115 \text{ Kft}}$$

$$MOT = 3.42 \times 4.0 = 13.68 \text{ Kft}$$

JOB NO. 26616 DATE 7-6-82 BY g/w CHK.  
CUSTOMER R.N.I.A PROJECT GROUND WATER TREATMENT  
SUBJECT BUILDING FOUNDATIONS

CORNER COLS (CONT).

$$\bar{X} = \frac{46.11 - 13.68}{26.38} = 1.23 \text{ ft.}$$

$$e = \frac{3.5}{2} - 1.23 = 0.52 \text{ ft.}$$

$$I = 12.5 \text{ in}^4$$

$$P = \frac{26.38}{12.25} + \frac{26.38 \times 0.52 \times 1.75}{12.5}$$

$$2.15 \pm 1.92 = 4.07 > 3.0$$

FOR PRELIMINARY DESIGN

USE 4'-0" Sq WITH #5 @ 12" CRS BOTH WAYS

USE SAME FOR PIER 1'-6" SQUARE  
4-#6 @ #3 TIES.

### EQUIPMENT FOUNDATIONS:

WITH EQUIPMENT BEING INSIDE BUILDING  
SEISMIC WILL CONTROL DESIGN OF FOUNDATION  
ABSORBERS W = 140K EACH, 9'-0" Ø, 23'-0" HIGH

$$V = ZKCW$$

$$= 0.25 \times 2.0 \times 0.1 \times 140 = 7.0 \text{ K}$$

$$OTM = 7.0 \times 11.5 = 80.5 \text{ K ft}$$

$$\begin{aligned} \text{RESISTING MOMENT} &= 140 \times 4.5 = 630 \text{ K ft} \\ + \text{BASE WEIGHT} &= 9.0 \times 9.0 \times 0.83 \times 0.15 \\ &= 10.12 \text{ K} \times 4.5 = 45.5 \text{ K ft} \end{aligned}$$

# Stearns-Roger

JOB NO. 26616 DATE 7-6-82 BY glo CH'K. 9  
CUSTOMER RMA PROJECT GROUND WATER TREATMENT  
SUBJECT FOUNDATION'S.

ADSORBERS (CONT).

$$\bar{X} = \frac{675.5 - 80.5}{150.12} = 3.96 \text{ ft}$$

$$e = \frac{9.0}{2} - 3.96 = 0.54 \text{ ft}$$

$$I = \frac{9.0 \times 9.0^3}{12} = 546.75 \text{ ins}^4$$

$$P = \frac{150.12}{81} \pm \frac{150.12 \times 0.54 \times 4.5}{546.75}$$

$$= 1.853 \pm 0.667 = + 2.52 \text{ ksf} \\ + 1.186 \text{ ksf}$$

$$\text{Min } A_s = 12 \times 10 \times 0.002 \\ = 0.24 \text{ Sq ins}$$

Use #4 @ 9" CRS (A<sub>s</sub> = 0.27)  
BOTH WAYS IN BOTTOM.

By inspection of ALL EQUIPMENT LOADS  
AND SIZE OF FOUNDATIONS, USE T/E ABOVE  
FOR ALL LARGE FOUNDATIONS

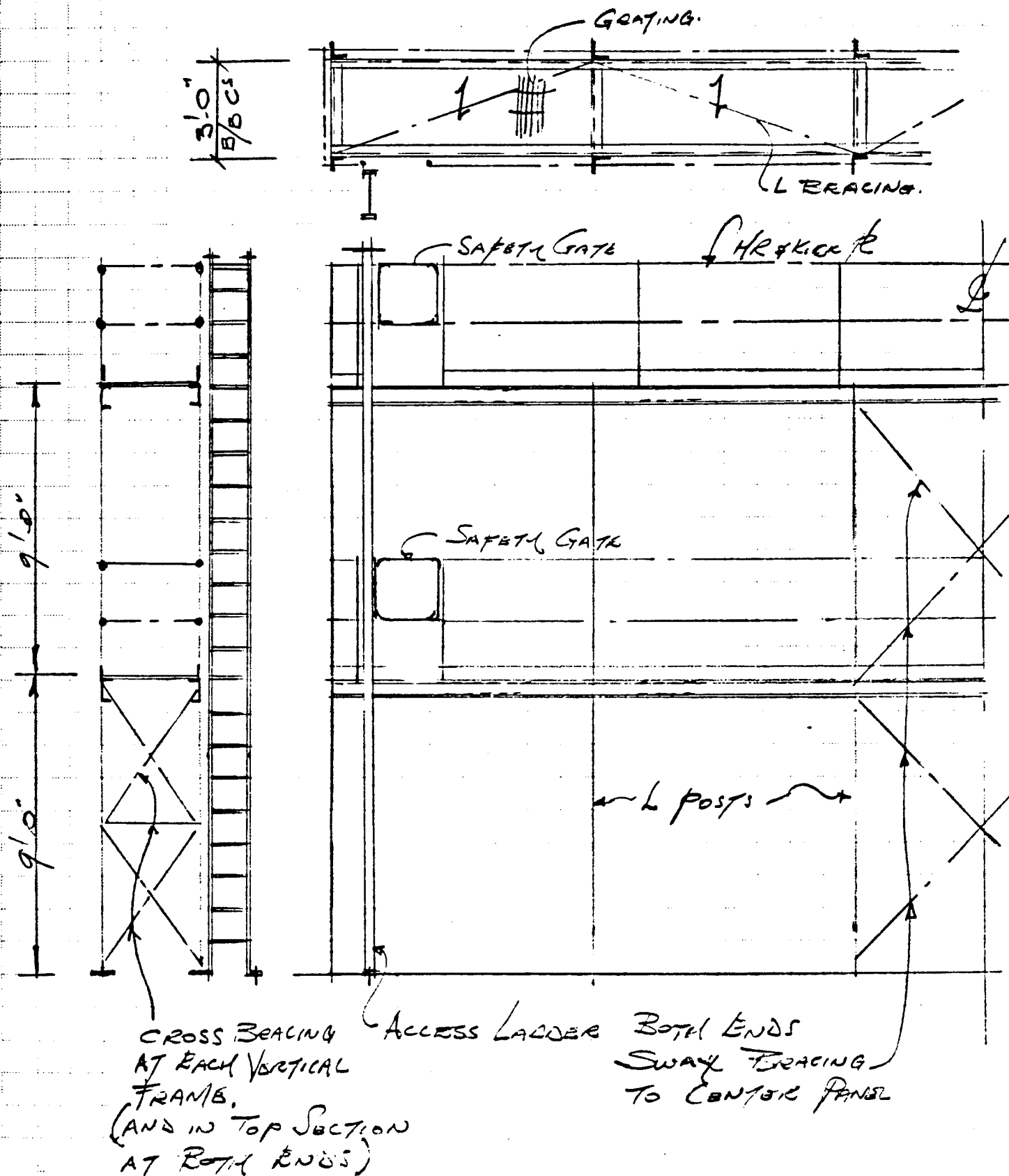
USE 1'-3" THICK SLAB + 2" GROUT ALLOWANCE  
UNDER ALL LARGE EQUIPMENT FOUND'S  
TO ALLOW FOR 1" Ø ANCHOR BOLT PULL OUT CAPACITY  
& EMBEDMENT LENGTH OF 12"  
FOR FLOOR SLAB 6" THICK REINFORCED WITH  
ONE LAYER WWT 4x4 - W4.0 x W4.0

# Stearns-Roger

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JOB NO. 26616 DATE 7-6-82 BY gfw CH'K.  
CUSTOMER R.M.A. PROJECT GROUND WATER TREATMENT  
SUBJECT WALKWAY ACCESS TO ADSORBERS.



# Stearns-Roger

PAGE 1

JOB NO. 26616 DATE 7-8-82 BY TKO CH'K. JMC  
CUSTOMER Rocky Mtn Arsenal PROJECT RAW WATER TREATMENT FACILITY  
SUBJECT TOILET ROOM

## VENTILATION

SIZE OF ROOM 6' W x 8' L x 9' H → FROM ARCH.

MIN. VENTILATION = 10 AC / HR. PER TMS-810-1 PG. 22

$$VOLUME OF ROOM = (6')(8')(9') = 432 \text{ FT}^3$$

$$\therefore \text{MIN CFM} = (432 \text{ FT}^3) \left( \frac{10}{\text{HR}} \right) \left( \frac{\text{HR}}{60 \text{ MIN}} \right) = 72 \text{ CFM}$$

COST OF FAN FROM MEAD 1982 PG 226 ⇒ \$63.00  
INSTALLATION = 1 M. H.

20 FT DUCTWORK @ .66 / FT ⇒ COST = \$13.20  
INSTALLATION ⇒ .03 M. H. / FT  
TOTAL = 1 M. H.

WALL GRILLE → 6" x 6" COST = \$5.00  
LABOR = 1 M. H.

JOE NO. 26616 DATE 7-8-82 BY \_\_\_\_\_ CH'K. JMC  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT TOILET ROOM

HEATING

TWO OUTSIDE WALLS  $\Rightarrow U = .15 \frac{\text{BTUH}}{\text{CF} \cdot \text{FT}^2}$

AREA WALL 1  $8' \text{ W} \times 8' \text{ H} = 64 \text{ FT}^2$   
WALL 2  $6' \text{ W} \times 8' \text{ H} = 48 \text{ FT}^2$

TOTAL AREA = 112 FT<sup>2</sup>

DESIGN TEMP FROM TMS-810-1, PG 1, TEMP = 60°F  
FROM TMS-785 WINTER DESIGN DRY-BULB  $\Rightarrow 97.5\% = 10^\circ\text{F}$   
 $\therefore \Delta T = 10^\circ\text{F}$

$$\therefore \Delta T = 60 - 1 = 59^\circ\text{F}$$

$$\therefore Q = (U \cdot A \cdot \Delta T) = (.15)(112)(59) \\ Q_{\text{OUTSIDE}} = 990 \text{ BTUH}$$

ESTIMATE U VALUE OF INTERNAL WALLS & CEILING = .30  $\frac{\text{BTUH}}{\text{CF} \cdot \text{FT}^2}$   
FROM ASHRAE 1981 FUNDAMENTALS TABLE 4C PG 23.21

$\therefore$  AREA OF WALLS = 112 FT<sup>2</sup> SAME AS EXTERIOR WALLS  
AREA OF CEILING =  $8' \times 6' = 48 \text{ FT}^2$

$$\therefore \text{TOTAL AREA} = 160 \text{ FT}^2 \\ \Delta T = 60 - 40 = 20^\circ\text{F}$$

$$\therefore Q = U \cdot A \cdot \Delta T = (.3)(160)(20^\circ\text{F}) \\ = 960 \text{ BTUH}$$

$$\therefore \text{TOTAL HEAT NEEDED} = 960 + 990 = 1950 \text{ BTUH} \sim 2000 \text{ BTUH} \\ \sim 600 \text{ W}$$

# Stearns-Roger

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JOB NO. \_\_\_\_\_ DATE \_\_\_\_\_ BY TJO CH'K. JMC  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

DESIGN USING INFRARED HEATING.

FOR A DAYTON 550 W, GRANGER STOCK # SH374  
PRICE = \$47.00

120V  
THERMOJHT = \$40

USING A GENERAL ELECTRIC QH500 T3 500W INCANDESCENT  
LIGHT WITH A RECESSED FIXTURE. PRICE = \$15.00.

USE A THERMOJHT = \$40.00

TO BE ESTIMATED BY ELECTRICAL.

# Siearns-Roger

PAGE 1

JOB NO. 26616 DATE 7-1-82 BY TIC CH'K. JMC  
CUSTOMER Rocky Mtn. Arsenal PROJECT RAW WATER TREATMENT FACILITY  
SUBJECT HEAT LOAD CALC.

ASSUME U VALUES:

$$\left. \begin{array}{l} \text{WALL} = .15 \frac{\text{BTU}}{\text{F}^2 \cdot \text{FT}^2} \\ \text{ROOF} = .10 \frac{\text{BTU}}{\text{F}^2 \cdot \text{FT}^2} \end{array} \right\} \text{REF. DOD. 4270.1-M TABLE 9.2}$$

DESIGN INTERIOR TEMP = 40°F, REF: DOD 4270.1-M, CH. 9-2.1

CALC. OF HEAT LOAD.:

REF.: ASHRAE FUNDAMENTALS '1981 - 25.2

$$Q = UA \times TD$$

WINTER DESIGN DRY-BULB  $\rightarrow$  97.5% = 10°F TMS-785

$$\therefore TD = 40 - 1 = 39^\circ\text{F}$$

FROM ARCH. Dwg. ROOF AREA = (40 FT)(73 FT) = 2920 FT<sup>2</sup>

$$\text{WALL AREA} = 30 \text{ FT} (2(40 \text{ FT}) + 2(73 \text{ FT})) = 6780 \text{ FT}^2$$

$$Q = UA \Delta T \Rightarrow$$

$$Q_{\text{WALL}} = (.15)(6780)(39) = 3970 \text{ BTUH}$$

$$Q_{\text{ROOF}} = (.10)(2920)(39) = \underline{11400 \text{ BTUH}}$$

TOTAL HEAT LOAD FOR WINTER = 51100 BTUH DUE TO TRANSMISSION  
HEAT LOSS

# Stearns-Roger

PAGE 2  
JOB NO. \_\_\_\_\_ DATE \_\_\_\_\_ BY TLO CH'K. JML  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

PER ASHRAE CH 22.8 ESTIMATE 1 A.C./HR. DUE TO INFILTRATION  
 $\therefore \text{VOLUME OF AIR} \Rightarrow (30)(40)(73) = 87600 \text{ FT}^3$   
 $\therefore Q = (1.08)(.825)(\text{CFM})(\Delta T)$   
 $= (1.08)(.825)(87600)(t_i - t_o)(40-1)$   
 $= 50800 \text{ BTUH}$

$\therefore \text{HEAT LOAD DUE TO INFILTRATION} = 50800 \text{ BTUH}$

HEAT LOAD THRU SLAB  $\Rightarrow$  ASHRAE 1981 FUNDAMENTALS  $\Rightarrow 25.8 \Rightarrow 25.9$

$$Q = F_2 P (T_i - T_o)$$

EST. FOR A METAL STUD WALL WITH INSULATION  $F_2 = .53$   
 $P = \text{PERIMETER OF SLAB} = (2)(40') + 2(73') = 226 \text{ FT}$

$$\therefore Q = (.53)(226)(40-1) = 4670 \text{ BTUH}$$

$\therefore \text{HEAT LOAD DUE TO FLOOR SLAB} = 4670$

$$\therefore \text{TOTAL DESIGN HEAT LOAD} = \begin{array}{r} 51100 \\ 50800 \\ \underline{4670} \\ 106570 \text{ BTUH} \end{array}$$

ADD 15% SAFETY FACTOR  $\Rightarrow (1.15)(106570) \text{ BTUH} = 122560 \text{ BTUH}$

# Stearns-Roger

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JCB NO. \_\_\_\_\_ DATE \_\_\_\_\_ BY TKO CH'K. JMC  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

HEATING LOAD = 122,560 BTUH

USE 4 MODINE PA-50 HEATERS

RATED: INPUT 50,000 BTUH

OUTPUT: 40,000 BTUH

DERATED: INPUT:  $(.84)(50,000) = 42,000 \text{ BTUH}$   
OUTPUT:  $(.84)(40,000) = 33,600 \text{ BTUH}$

TOTAL CAPACITY: INPUT:  $(4)(42,000) = 168,000 \text{ BTUH}$   
OUTPUT:  $(4)(33,600) = 134,400 \text{ BTUH}$

HEAT THROW (FE): 23

PROPANE: 20 CFH EA. OR 80 CFH TOTAL

COST FOR UNIT HEATER: \$420.00 EA WITH INTERMITTENT PLOT  
LACK . 16 M. H. TOTAL

COST FOR 5" DIA. VENT CHIMNEY: 5" DIA → 100 FT

MATERIAL: \$2.50 L.F. → \$250.00

LACK: 25 M. H. .25 M.H. / L.F.

THERMOSTATS B-C TA-121 MATERIAL \$55 EA.

PIPING . 3/4" → 200' TOTAL PIPING

50' UNDERGROUND → 16 M. H. + TRENCH

150' HUNG → 24 M. H.

MATERIAL \$1.00 LF → \$200

FITTINGS → \$200

# Stearns-Roger

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JOB NO. 26616 DATE 7-7-87 BY TKO CHK. JMC  
CUSTOMER ROCKY Mtn. ARSENAL PROJECT RAW WATER TREATMENT FACILITY  
SUBJECT CALC. OF PROPANE USAGE

REF. HEAT LOAD CALCULATIONS.

$$\begin{aligned} \therefore Q_{\text{WALL}} &= (1.15)(6780)(\Delta T) = (1017)(\Delta T) \\ Q_{\text{ROOF}} &= (1.10)(2920)(\Delta T) = (292)(\Delta T) \\ Q_{\text{TRANSMISSION}} &= (1017 + 292)(\Delta T) = (1309)(\Delta T) \\ Q_{\text{INFILTRATION}} &= (1.08)(.825)(87600)(\frac{1}{60})(\Delta T) \\ &= (1301)(\Delta T) \\ Q_{\text{SLAB}} &= (.53)(226)(\Delta T) = (120)(\Delta T) \\ \therefore Q_{\text{TOTAL}} &= (1.15)(1309 + 1301 + 120)(\Delta T) \\ &= (3140)(\Delta T) \end{aligned}$$

REF. ASHRAE SYSTEMS 43.12 FOR DENVER AREA

OUTDOOR TEMP	HRS	BTUH @ 1°F	ΔT 40°F	BTUH HEAT LOSS	TOTAL BTU
37	717	3140	3	9420	6754140
32	721		8	25120	18111520
27	553		13	40820	22573460
22	359		18	56520	20290680
17	216		23	72220	15599520
12	119		28	87920	10462480
7	78		33	103620	8082360
2	36		38	119320	4295520
-3	22		43	135020	2970440
-8	6		48	150720	904320
-13	1		53	166420	166420
-18	1		58	182120	182120

TOTAL

110392980 BTU

ASSUME 80% EFFICIENCY ON HEATERS  $\Rightarrow \frac{110392980}{.80} = 137,911,230 \text{ BTU}$

$\frac{92000 \text{ BTU}}{\text{GAL. PROPANE}} \Rightarrow \text{GAL PROPANE} = \frac{137,911,230}{92000} = 1500 \text{ GAL}$

$\therefore$  DESIGN YEARLY USE OF PROPANE = 1500 GAL

# Stearns-Roger

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JOB NO. 26616 DATE 7-7-82 BY TKO CH'K. JNC  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

∴ SIZE FOR 1000 GAL PROPANE TANK TO BE FILLED  
MONTHLY IN THE WINTER

COST OF TANK : \$1500.00  
REGULATING VALVE : \$50.00

MUST INSTALL TANK 25FT MIN FROM BLDG.

INSTALLATION: 16 M.H.

HANGERS FOR THE HEATERS → \$20.00 FOR EA. HEATER  
TOTAL COST = \$80.00

ISOLATION VALVES FOR HEATERS AND REGULATOR, ∴ 10 VALVES  
\$10.00 EA.

VENT CAP @ \$20 EA. ∴ \$80.00

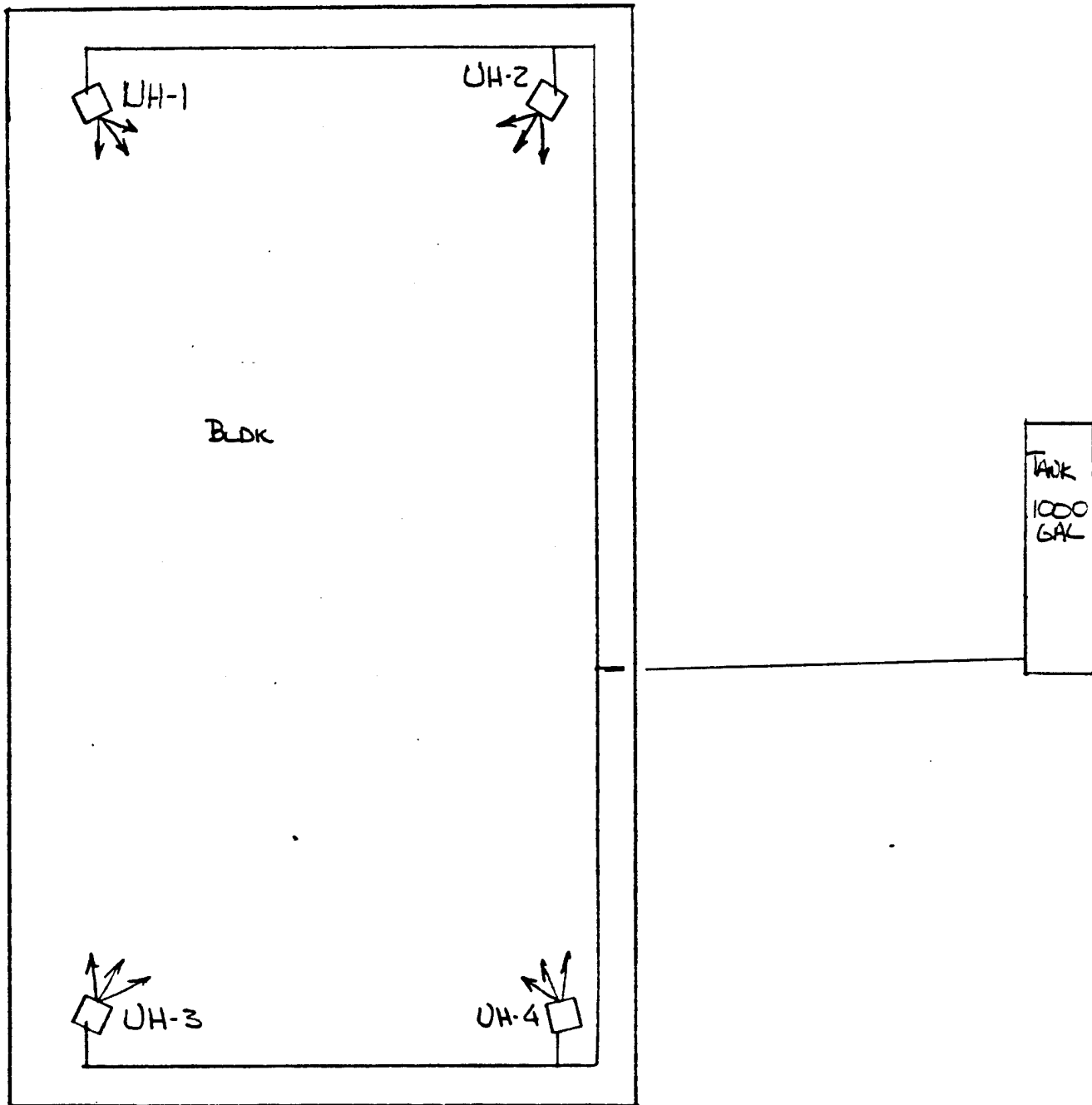
# Stearns-Roger

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JOB NO. \_\_\_\_\_ DATE \_\_\_\_\_ BY TKC CH'K. JMC

CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_

SUBJECT \_\_\_\_\_



# Stearns-Roger

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JOB NO. 26616 DATE 7-7-82 BY TKO CH'K. JMC  
CUSTOMER ROCKY MTN. ARSENAL PROJECT RAW WATER TREATMENT FAC  
SUBJECT COOLING LOAD

ASHRAE FUND. 1981 PG. 26.3  $Q = U \cdot A \cdot CLTD$

COOLING LOAD DUE TO ROOF

$$U = .10 \frac{\text{BTUH}}{\text{F} \cdot \text{FT}^2} \text{ DOD 4270.1-M TABLE 9.2}$$

$$A = (40') (75') = 3000 \text{ FT}^2$$

CLTD  $\Rightarrow$  ASHRAE FUND. PG. 26.8

TABLE 5A CLTD = 79°F @ 14:00

$$\text{PG. 26.8 } CLTD_{\text{CORR}} = [(CLTD + LM)K + (T_b - T_r) + (T_o - 85)] \cdot f$$

WHERE  $T_{\text{room}} = 102^\circ\text{F}$  EQUIPMENT MAX. TEMP.

$T_{\text{outside}} = 91^\circ\text{F}$  97.5% SUMMER DRY BULB TMS-785

$f = 1.0$  NO ATTIC

$LM = 2$  FROM TABLE 9A

$K = 1.0$  INDUSTRIAL AREA

$$\therefore CLTD_{\text{CORR}} = (79 + 2) + (78 - 102) + (91 - 85) \\ = 63^\circ\text{F}$$

$$\therefore Q_{\text{ROOF}} = (.10) (3000) (63) = 18900 \text{ BTUH}$$

COOLING LOAD DUE TO WALLS

$$U = .15 \frac{\text{BTUH}}{\text{F} \cdot \text{FT}^2} \text{ DOD 4270.1-M TABLE 9.2}$$

AREAS OF WALL  $\rightarrow$  NORTH AREA =  $A_N = (40') (30') = 1200 \text{ FT}^2$

SOUTH AREA =  $A_S = (40') (30') = 1200 \text{ FT}^2$

EAST AREA =  $A_E = (75') (30') = 2250 \text{ FT}^2$

WEST AREA =  $A_W = (75') (30') = 2250 \text{ FT}^2$

FROM TABLE 6 GROUP B WALL

$\therefore$  FROM TABLE 7A : NORTH WALL @ 2:00 CLTD<sub>N</sub> = 9°F

SOUTH WALL @ 2:00 CLTD<sub>S</sub> = 12°F

EAST WALL @ 2:00 CLTD<sub>E</sub> = 22°F

WEST WALL @ 2:00 CLTD<sub>W</sub> = 14°F

$$\text{PG. 26.12 } \Rightarrow CLTD_{\text{CORR}} = (CLTD + LM) \cdot K + (T_b - T_r) + (T_o - 85)$$

SAME DESIGN CONDITIONS AS ABOVE

# Stearns-Roger

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JOB NO. 26616 DATE 7-7-82 BY TKO CH'K. JML  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

$$CLTD_{CORR_N} = (9+1)(1.0) + (78-102) + (91-85) \\ = -8^{\circ}F$$

$$CLTD_{CORR_S} = (12-1) + (78-102) + (91-85) \\ = -7^{\circ}F$$

$$CLTD_{CORR_E} = (22+1) + (78-102) + (91-85) \\ = 5^{\circ}F$$

$$CLTD_{CORR_W} = (14+1) + (78-102) + (91-85) \\ = -30^{\circ}F$$

$$\therefore Q_{NORTH WALL} = (.15)(1200)(-8) = -1440 \text{ BTUH} = Q_{NW}$$

$$Q_{SOUTH WALL} = (.15)(1200)(-7) = -1200 \text{ BTUH} = Q_{SW}$$

$$Q_{EAST WALL} = (.15)(2250)(5) = 1690 \text{ BTUH} = Q_{EW}$$

$$Q_{WEST WALL} = (.15)(2250)(-3) = -1010 \text{ BTUH} = Q_{WW}$$

$$\therefore \text{TOTAL } Q \text{ FROM WALLS} \Rightarrow Q_W = Q_{NW} + Q_{SW} + Q_{EW} + Q_{WW} \\ = -1440 - 1200 + 1690 - 1010 \\ Q_W = -2020 \text{ BTUH}$$

$$\therefore \text{TOTAL TRANSMISSION GAIN} = Q_{ROOF} + Q_{WALL} = 18900 + (-2020) \\ \therefore Q_T = 15180 \text{ BTUH}$$

ESTIMATE LIGHT LOAD =  $1 \text{ W/FT}^2$

USE INCANDESCENT LIGHTS

$$AREA = (40' \times 75') = 3000 \text{ FT}^2$$

$$Q_L = (1 \text{ W/FT}^2)(3000 \text{ FT}^2)(3.4 \text{ BTUH/W})$$

$$Q_L = 10200 \text{ BTUH}$$

# Stearns-Roger

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JCB NO. 24616 DATE 7-7-82 BY TKO CH'K. JMC  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

ESTIMATE EQUIPMENT, PUMP & AIR COMPRESSOR MOTOR LOADS  
TO BE 20 H.P. TOTAL. FROM ASHRAE 1981 FUNDAMENTALS  
TABLE 24, PG. 26.29 MOTOR IN, DRIVEN EQUIPMENT OUT OF THE  
AIR STREAM :

$$Q_m = 7610 \text{ BTUH}$$

## PERSONNEL LOAD

FROM ASHRAE 1981 FUND., TABLE 18, PG. 26.25 LIGHT BENCH  
WORK, MALE

$$Q_p = 880 \text{ BTUH}$$

∴ TOTAL DESIGN HEAT LOAD IN THE BLDG.

15180 BTUH → TRANSMISSION

10200 BTUH → LIGHTING

7610 BTUH → MOTORS

880 BTUH → PERSONNEL

$$Q_{\text{TOTAL}} = 33870 \text{ BTUH}$$

ADD 20% SAFETY FACTOR

$$\therefore Q_{\text{TOTAL}} = (1.2)(33870) = 40650 \text{ BTUH}$$

DESIGN FOR A ROOM TEMP. = 102°F

OUTSIDE AIR TEMP. = 91°F

$$\therefore \Delta T = 11^\circ\text{F}$$

∴ AMOUNT OF VENTILATION AIR ⇒

$$\text{CFM} = \frac{Q}{(1.08 \times 0.825)(\Delta T)} = \frac{40650}{(1.08 \times 0.825)(11)}$$

$$\text{CFM} = 4150$$

JOB NO. 26616 DATE 7-7-82 BY JKO CH'K. JMC  
CUSTOMER \_\_\_\_\_ PROJECT \_\_\_\_\_  
SUBJECT \_\_\_\_\_

ACCORDING TO TMS-810-1 PG. 20 DESIGN USING GRAVITY AIR  
MOVERS WITH MANUAL SHUT OFF DAMPERS BASED ON A WIND  
VELOCITY OF 4MPH.

DESIGN FOR A STACK HEIGHT OF 30 FT AND A TEMP. DIFF. OF 10°F.

∴ DESIGN USING A PENN POL-AIR RIDGE GRAVITY ROOF  
VENTILATOR AT DESIGN CONDITIONS ⇒  $359 \frac{\text{CFM}}{\text{FT}^2}$  OPENING

$$\therefore \text{OPEN AREA NEEDED} = \frac{4150 \text{ CFM}}{359 \text{ CFM/FT}^2} = 11.6 \text{ FT}^2$$

FROM PERFORMANCE TABLE A 12 IN X 10 FT LONG UNIT HAS  
A CAPACITY OF 2620 CFM. THEREFORE 2 UNITS ARE  
NEEDED.

COST OF EACH UNIT IS \$400<sup>00</sup>.

DESIGNED AROUND ARNICO. INFORMATION ON UNITS ARE NOT GIVEN.  
SINCE LOUVERS ARE NOT INSTALLED FOR MAKE-UP AIR AND THE  
EFFICIENCY OF ARNICO GRAVITY AIR MOVERS IS UNKNOWN SEE  
FOR THREE UNITS AT 12 IN. WIDE X 10 FT LONG.

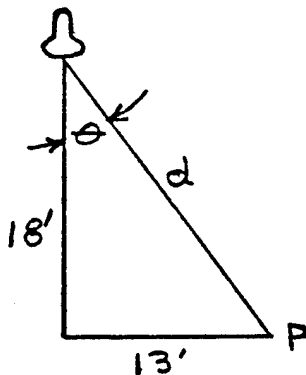
JOB NO. C-26616 DATE 7-8-82 BY WEW CHN \_\_\_\_\_  
CUSTOMER COE - RMA PROJECT N.W. BOUNDARY CONTAIN/TREAT. SYS  
SUBJECT CONCEPT LIGHTING CALC. - BLDG. INTERIOR

BLDG. INTERIOR DIMENSIONS (APPROX)

75 FT X 39 FT X 29 FT HIGH

FIXTURE TYPE: PRISMATIC GLASS REFLECTOR  
MFR.: HOLOPHANE  
CAT. NO.: 1938  
LAMP: 150 W HPS  
MTG. HT.: 18 FT

FOOTCANDLE CALCULATION AT 13 FT FROM  
0° (NADIR) —



$$\tan \theta = \frac{13}{18}, \theta = 35.84^\circ$$

$$d = \sqrt{13^2 + 18^2} = 22.2'$$

$$I \approx 5300 \text{ (FROM PHOTOMETRIC TEST DATA)}$$

$$E = \frac{I}{d^2} \cos \theta$$

$$= \frac{5300}{(22.2)^2} \cos 35.84^\circ = 8.7 \text{ FC}$$

AT "P"

USE 6 FIXTURES (2 ROWS OF 3 EACH)

THE CONTRIBUTION OF ILLUMINATION FROM  
6 LTG. UNITS WILL INCREASE THE AVERAGE  
ILLUMINATION TO AN ESTIMATED 20 FC AT  
THE WORK PLANE.